U.S. Army Research Institute for the Behavioral and Social Sciences

Research Report 1850

Training Lessons Learned and Confirmed From Military Training Research

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April 2006

U.S. Army Research Institute
for the Behavioral and Social Sciences

A Directorate of the Department of the Army
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REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
April 2006	Final	June 2003 to December 2004

4. TITLE AND SUBTITLE Training Lessons Learned and Confirmed From Military Training Research	5a. CONTRACT OR GRANT NUMBER DASW01-99-D-0013 DO#31 5b. PROGRAM ELEMENT NUMBER 622785
6. AUTHOR(S) Richard L. Wampler (Northrop Grumman), Jean L. Dyer (U.S. Army Research Institute), Stephen C. Livingston, Paul N. Blankenbeckler, James H. Centric, and Michael D. Dlubac (Northrop Grumman)	5c. PROJECT NUMBER A790 5d. TASK NUMBER 215 5e. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Northrop Grumman 3565 Macon Road Columbus, GA 31907 U.S. Army Research Institute for the Behavioral and Social Sciences Infantry Forces Research Unit PO Box 52086 Fort Benning, GA 31995-2086	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U. S. Army Research Institute for the Behavioral & Social Sciences ATTN: DAPE-ARI-IJ 2511 Jefferson Davis Highway, Arlington, VA 22202-3926	10. MONITOR ACRONYM ARI 11. MONITOR REPORT NUMBER Research Report 1850

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Contracting Officer's Representative: Jean L. Dyer
Subject Matter POC: Richard Wampler

14. ABSTRACT *(Maximum 200 words)*:

The report summarizes lessons learned regarding military training that were accumulated over a six-year period of training research. These lessons include new insights regarding training as well as lessons that reinforce basic principles of training and learning. The findings are based on the authors' observations and assessments of training as well as training experiments. Much of the training involved new and emerging training technologies. Some of it focused on training with futuristic equipment. Live, virtual, and constructive training environments were observed. The report integrates the lessons learned and insights regarding training that were documented in prior reports, as well as those that were not officially documented. These lessons should be useful as new equipment is developed and training programs are designed. The report is intended for use by military trainers, training designers, and training developers in institutional training environments and in operational units.

15. SUBJECT TERMS

Training Lessons Learned Training Technology Training Evaluation Military Training Training Concepts Applied psychology

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	58	Ellen Kinzer, Technical Publication Specialist 703.602.8047

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April 2006

Army Project Number
622785A790

Personnel Performance
and Training Technology

TRAINING LESSONS LEARNED AND CONFIRMED FROM MILITARY TRAINING RESEARCH

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army is facing many challenges simultaneously. It is fighting wars in Afghanistan and Iraq. It is also intrinsically involved in the Global War on Terrorism, and as such has forces deployed around the world. The Army is also undergoing a transformation to make it a more strategic, mobile, and lethal force. Research is being conducted to develop new equipment to support that transformation. This is occurring in the face of severe resource restrictions, most significantly in the arenas of time and money. Yet the Army must continue to train and look to the future to determine how it can train more effectively and efficiently. The report describes new training lessons learned and identifies specific principles of training and learning that should be reinforced in future training design, development, and execution. The research upon which the report is based included training efforts for different items of new equipment, digital systems, and a variety of experimental programs from across the spectrum of training within the U.S. Army.

Procedure:

The report encompasses training research conducted over an eight-year period from 1997 to 2004. The training lessons learned were derived from research efforts and observations in different training domains. The primary research efforts involved digital systems, interactive courseware, training simulations, new dismounted Soldier systems, and institutional training courses. In addition, some insights were made from the experiences of the authors who, collectively, have extensive experience in military training, training development and research, human behavior, and military operations. The lessons learned were organized around the following major training areas: instructional system design, and the live, virtual, and constructive training milieus. Lessons learned were linked to the psychological literature on learning and training. Other general lessons that apply across multiple areas were included.

Findings:

Some training lessons were new. Other lessons were not new, but were still applicable to new technologies and today's Soldier population. Variations from the traditional crawl-walk-run training approach were identified, to include techniques to facilitate performance under differing conditions. The importance of knowing the entry level of Soldiers, of standardizing Soldier assessments, of specifying details for practical exercises, of providing feedback under varying training conditions and media, and of allocating sufficient training time was stressed. Techniques for making material more meaningful to Soldiers, for sequencing training, and for integrating individual and collective training were suggested. Considerations for using training simulations were presented.

Lessons learned regarding efficient and effective procedures for interactive courseware development were cited. Finally, several lessons to support preparing for and conducting after action reviews were offered.

Utilization and Dissemination of Findings:

These lessons can be used by Army trainers and training developers across the spectrum of training environments, from the TRADOC schools to operational units. Trainers can develop and present higher quality training that better prepares Soldiers for the future battlefield. In addition, program managers for new equipment systems should ensure training and training strategies for their new equipment recognize and accommodate these lessons. Designers and developers of training support packages should take advantage of the benefits offered by these lessons. Each training lesson, whether new or a previous lesson that was confirmed, is applicable to the design and development of training to help alleviate the training burden, and to ensure future leaders and Soldiers are trained to accomplish their missions.

TRAINING LESSONS LEARNED AND CONFIRMED FROM MILITARY TRAINING RESEARCH

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Introduction

The face of warfare has changed rapidly since the end of the Cold War. Instead of facing a numerically superior enemy with technologically advanced weaponry and predictable doctrine, the Army now faces a wide variety of adversaries and potential adversaries with less sophisticated weapons and unknown doctrinal practices. The battlefield is changing as well. There are no longer clearly defined front lines, boundaries, and logistical bases. The enemy has taken on a new face, able to melt into the fabric of nations the United States seeks to assist or rebuild. It is becoming more and more difficult to determine how to defeat the enemy.

The Army learned from the Gulf War in 1991 that its ground forces were extremely heavy and difficult to deploy rapidly. This was unacceptable. The Army, as did the other branches of service, began to look at ways to transform to a force that could meet the new challenges it faced (Department of the Army [DA], 2003).

Achieving a ready Current Force today and a transformed Future Force tomorrow requires a transformation not only in equipment, but also in the way units and individuals train for operations. This report summarizes lessons learned, from a diversity of training research projects, regarding how Soldiers learn and effective means of training. Some lessons are new; some are not new. Most can be traced to basic concepts underlying psychological principles of learning and training.

Transformation of the Army

The Army frames its transformation through the interaction of constantly evolving capabilities from Current to Future Forces. The Current Force is the operational Army of today, trained and equipped to conduct operations as part of today's Joint Force. The Future Force is the operational force the Army continuously seeks to become. The Future Force is the strategically responsive, joint interdependent, precision maneuver force, dominant across the full range of military operations envisioned for the future global security environment. While the Army develops the Future Force, it simultaneously accelerates capabilities to enhance the Current Force. Similarly, the operational experience of the Current Force directly contributes to identifying further requirements toward Future Force capabilities (DA, 2003).

The Army must develop Soldiers and leaders who are competent and confident in their ability to perform and lead at the levels assigned. To meet the needs in current and future operational environments, training must prepare leaders and Soldiers to learn, improvise, and adapt to constantly changing threats in addition to executing missions and tasks to standards. Training must also accommodate the unique requirements of the Active Component and the Reserve Component to assure total force readiness. The Army's Training Transformation initiative provides dynamic, capabilities-based, training and mission rehearsal for Army forces to accomplish their mission in joint operations. Objectives for the Army's initiative (DA, 2003) include:

- Preparing forces for new warfighting concepts
- Continuously improving joint force readiness by applying training resources to joint education and training to fulfill combatant command requirements
- Developing individuals and organizations that intuitively think joint
- Developing individuals and organizations that improvise and adapt to emerging crises and rapidly incorporate operational experiences and lessons learned
- Achieving unity of effort from a diversity of training means

Training transformation begins by changing behaviors of leaders and Soldiers. Creating, storing, imparting, and applying new knowledge throughout the force, individually and collectively, fosters these changes.

Digitization of the Individual Soldier

One component of force transformation is the introduction of digital systems. The Army began to give tactical commanders a better situational awareness (SA) and understanding of the battlefield in the early 1980s with such equipment as the Army Tactical Command and Control System (ATCCS) and the Maneuver Control System (MCS). The speed and agility of the M1 Abrams tank and M2 Bradley Fighting Vehicle dictated a more reliable and faster means of providing command and control to commanders at all levels. The need to help analysts quickly sort through a high volume of enemy information via a digital intelligence system led to development of the All Source Analysis System (ASAS).

The advancement of ATCCS, with the successful efforts of MCS and ASAS, has been phenomenal. Other digital systems developed include the Advanced Field Artillery Tactical Data System, the Forward Area Air Defense Command and Control and Intelligence System, and the Combat Service Support Computer System (CSSCS). As a result of these programs and the need for a coordinated digitized system for battlefield commanders, the Force XXI Battle Command for Brigade and Below (FBCB2) was created in 1995 (Hart, 2002). The FBCB2 system allowed commanders to accurately know where their own units were, the sustainment status of their units (integration of CSSCS), where adjacent units were and what they were doing (integration of MCS), and where the enemy was located (integration of ASAS). It also allowed combat vehicle crewmen to know the same information, with custom filters and alerts to provide them with only the information they needed on the battlefield.

A major shortcoming of digitized capabilities was that once infantry Soldiers dismounted from their vehicles, they lost this information advantage, as the individual Soldier lacked a digital capability. In the early 1990s, the Army decided the Soldier should have the technology to provide him SA and access to the firepower he would need to dominate any potential enemy force. Further requirements for dismounted Soldiers to have connectivity with the mounted force have evolved since then (Federation of American Scientists, 1999). The Land Warrior program and a science and technology program known as Future Force Warrior are underway. When completed, the infantry Soldier will have a level of SA and situational understanding heretofore unknown in the history of warfare. Each Soldier will wear a computer that provides connectivity to other digital systems. This allows Soldiers to see maps and imagery, to send and receive both voice and digital messages, to know where friendly forces are located, and quickly be made aware of developments on the battlefield or changes to the enemy situation. If Soldiers are properly trained, they will be empowered to act on initiative, knowing what leaders want, the desired end-state, where buddies are, where the enemy is, and the ability to access information systems that even a brigade commander could not have access a decade ago.

Application of Lessons Learned

The key phrase in transformation is "properly trained." Training cannot be a trial and error situation, given the challenges the Army is facing with transformation from the Current to the Future Force --- fighting more than one war simultaneously, and operating at a very high operational tempo with limited resources. The Army must get it right the first time. Lessons learned must not become lessons that are relearned, repeatedly manifesting themselves in the after action reviews (AARs) and training take-home packages from the major combat training centers. Lessons must be learned from training events and combat operations. They must be shared for future training optimization, and increased awareness of these lessons should be achieved within the training community.

The report is confined to training lessons which the authors have learned in the course of their training research. It does not incorporate lessons derived from other Army training research in which the authors did not participate. In addition, no future research directions were derived.

Method

The findings in this report focus on the training research in which the authors participated during the period from 1997 to 2004. Some training lessons are new. Other lessons have been previously recognized, but are repeated in order to emphasize their impact and relevance, and how they apply to future training. Some lessons learned were explicitly documented in the reports emanating from the research. Other lessons learned were not documented as they did not address the purpose of the original report. Instead, these lessons represent secondary effects or effects that emerged from multiple efforts. Additionally, some insights were made regarding training based on the experience of the authors as data collectors and observers during the training research, as well as the authors' experience in developing training media and were not specifically documented in the reports. Consequently, the training lessons were derived not from one single report or observation, but from several reports and numerous observations. Where common threads were found, they were combined to avoid repetition and the possible lessening of the impact of their value.

The authors of this report have a total of over 200 years of experience in military training, training development and research, human behavior, and instructional design. During their professional careers in the military or as behavioral science researchers, these individuals accumulated a wealth of experience in what works and what does not work. As such, the lessons learned from this body of research are placed in the broader context of the authors' prior training research experience, military training, and operational experiences.

The reports used in the compilation of these training lessons are listed in Appendix B, rather than referenced in the text. These reports are not cited in the text, because, as stated previously, not all reports expressly documented a lesson learned. In addition, some lessons represent an integration of data and observations with the authors' prior training experiences. The training and training technologies covered in these reports include training for new Soldier systems, new programs of instruction, interactive courseware (ICW), emerging virtual training environments including game technologies, live training (e.g., live-fire, collective training, field exercises), and constructive simulations.

Training Observations, Development, Research, and Delivery

The lessons learned are based on several types of training and research experiences: the authors' observations of ongoing military training, development of training materials by the authors, training research conducted by the authors, and presentation/delivery of training by the authors themselves. The authors observed training conducted in instructor-led classroom settings, in settings where ICW was used, and in live (e.g., field exercises, training areas, firing ranges), virtual, and constructive training environments. Hundreds of hours of observations were spent by the authors as data collectors and as training evaluators. These observations were conducted to evaluate the means/media by which the training was delivered, as well as the content of training programs that are part of the Army professional education system for officers and non-commissioned officers. In many cases, the observations involved training that integrated future combat capabilities into training programs that were under development. Insights and experience from these various training-related observations are included in this report.

The authors also designed and developed training for delivery to Soldiers who were taking Army courses and for inclusion in training experiments and evaluations. These design and development efforts involved classroom instruction, small-arms live-fire exercises, ICW, and scenarios for virtual and constructive training experiments and milieus.

Some of the lessons learned are based on formal training experiments, where alternative means of training were compared. These experiments provided Soldier performance data that pertained directly to training effectiveness, as well as comparative information on the relative merit of different training approaches. In some experiments, the authors led an AAR, where Soldiers' discussed their performance, and information was obtained on what they needed to sustain and improve.

Types of Training

The lessons learned were placed in five training categories. The first category was Instructional System Design (ISD). Three categories, live (including instructor-led), virtual, and constructive training, were based on Training and Doctrine Command (TRADOC) Regulation 350-70 (1999). The remaining category covered other lessons learned. Each is defined below.

- *Instructional System Design (ISD).* The ISD process or concept serves as the basis for Army training development and evaluation. Individual and collective training were not used as training categories in this report. While these categories are commonly used to describe types of training, the distinction between the two was not directly relevant to the report, and there is much overlap when considering the basic lessons learned about training design, development and delivery.

- *Live training* is executed in field conditions using tactical equipment, enhanced by training aids, devices, simulators, and simulations (TADSS), and Tactical Engagement Simulation (TES) to simulate combat conditions. For the purpose of this report, the category of live training also includes instructor-led training; any training conducted by a qualified instructor in the subject area being taught. Training may take place in a classroom or a field location. Instructor-led training includes ICW, which is essentially instructor-led with the instructor being remote through video teleconferencing or online synchronous sessions, as well as individuals learning independently through multi-media instruction. The live training category includes the greatest variety of training approaches.
- *Virtual training* is executed using computer-generated battlefields in simulators with the approximate physical layout of tactical weapons systems and vehicles. Virtual training permits units to maneuver over much larger areas.
- *Constructive training* is the use of computer models and simulations to exercise the decision-making and other command and staff functions of units from platoons through echelons above corps.
- *Other training* refers to all training or training related information that does not fit into one of the above categories, and possibly overlaps multiple categories.

Results

Actual lessons learned and confirmed from training, training experiments, and training observations are provided in the Results section. The ISD lessons are presented first, followed by live training, then virtual and constructive training which are grouped together, and lastly, other training lessons. Just as a period of training or a certain type of training can be used for multiple purposes and in different settings, there is overlap among some of these training categories.

Instructional System Design (ISD) Lessons

The Army uses the Department of Defense ISD methodology, also known as the systems approach to training (SAT), as the fundamental sequence for designing, developing, and evaluating training. The model for this method is shown at Figure 1.

Each phase of the ISD process is neither stand-alone nor can it be divorced from any other phase of the model. Each part is dependent on the others, and the process is never completed. There is always room for improvement, and improvement based on experience and the evaluation of training results produces the most effective training.

During Phase I, Analyze, the instructional designer and developer must consider the training audience. This includes the status of what the audience already knows and does not know, or where the audience might have problems attaining proficiency. While this is shown in

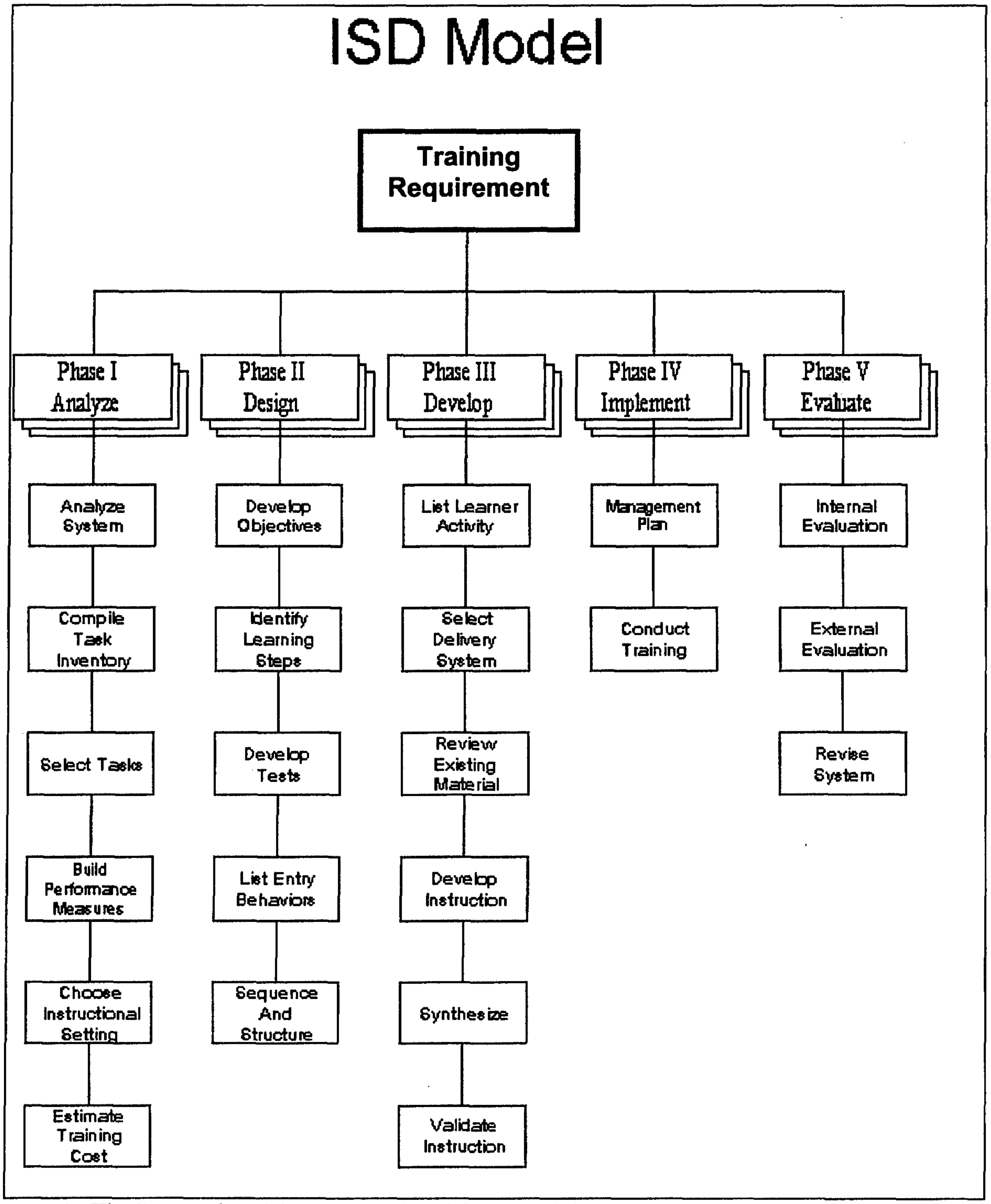

Figure 1. The Instructional System Design (ISD) Model. *Note.* From *Introduction to Instructional System Design,* by D. Clark, 2000, retrieved from http://www.nwlink.com/~donclark/hrd/sat1.html

the last step (Phase V) of the ISD model in Figure 1 as internal evaluation, knowledge of the student or target audience will drive the other phases of the ISD model. Most critically, it should drive the learning objectives under Phase II, and the development of the instructional media and approaches in Phase III. Task analysis and compiling the task list require that a subject matter expert (SME) and the instructional designer collaborate to determine which system or equipment tasks usrs must master in order to successfully perform their job. This analysis is then linked to the learning objectives. Also, developing tasks that are digestible training "chunks" helps students achieve proficiency. Consideration of the student population impacts the design of the sequence of instruction and the structure in which training will be presented.

The specific lessons learned on the ISD process are cited in Table 1. The topics are listed according to the sequence that they might be considered when using the ISD model to design and develop training.

Table 1
Instructional System Design (ISD) Lessons

- Recognize and accommodate diverse backgrounds (target audiences)
- Involve trainers in the design stages of new equipment
- Plan for and use a mix of instructional media and techniques
- Design training concurrent with new system, but develop training when most appropriate
- Select the appropriate training media and delivery methods for the intended task and audience
- Establish clear, measurable, and attainable objectives for the skills that must be acquired from the training
- Incorporate recent lessons from combat leaders

Recognize and accommodate diverse backgrounds (target audiences). Training in the Army presents a situation not readily found in the civilian community. That situation is the diversity of backgrounds found in Soldiers (officers and enlisted personnel): groups of Soldiers with vastly different learning capabilities, military knowledge and experience, and cultural and educational backgrounds who must be trained to common standards. In many cases this diversity creates situations that affect the individual's learning preferences and the speed with which an individual learns. For some there are language barriers, cultural barriers, educational barriers, or computer literacy barriers. Soldiers can also differ on such critical dimensions as eye-hand coordination (important for many military tasks), ability to learn on their own (important for self-development), and mathematical versus verbal aptitude. In addition to these individual factors, the trainer can build upon such collective dynamics as unit pride, a sense of belonging to the organization, and the loyalty to not let down the group, which usually exist in the military training environment. The instructional designer must consider each of these.

From training observations, we concluded that instruction accommodated to individual differences in Soldiers only when the immediate training situation demanded it, i.e., when individuals had problems. This is in contrast to an adaptive, instructional approach that is explicitly designed to accommodate individual differences (Corno & Snow, 1986). This adaptive approach could mean that the Soldier tests out of certain blocks of instruction, that the

Soldier progresses to a more difficult, challenging block of instruction, or that some other mode of accommodation to individual differences (peer teaching/coaching) is applied. The end result would be more efficient and effective training, by allowing each individual to be a constant, active participant in the learning process and mastery of skills. Such adaptive modes of training were rarely observed.

Even though the Soldier population as a whole is becoming more homogeneous with regard to computer skills, there are still differences (Dyer, 2002; Singh & Dyer, 2001, 2002). Some Soldiers are trained to be computer programmers; others are more likely to be primarily e-mail and Internet users. Some play games extensively; others do not (Beal & Christ, 2004). From the training observations we learned that differences in computer skills, military knowledge, and even the ability to type could interact to impact performance, and confirmed the need to use different or tailored training approaches. For example, when a new Army system, which uses digital skills, had to be mastered by Soldiers ranging from privates to captains, those individuals with stronger computer backgrounds and more military knowledge learned the system faster and understood how to employ it more quickly than those with weak computer backgrounds and less military knowledge. Similar differences in rates of learning were observed with Soldiers using some military training games.

With some tasks, diversity in Soldier backgrounds does not greatly impact training approaches. An example would be basic airborne training that is the same for all Soldiers, regardless of rank. Knowing how to don the parachute, procedures to follow inside the aircraft, emergency and safety procedures, and proper landing techniques are the same for every basic parachutist.

In conclusion, the training designer/developer must fully understand the tasks and skills required, the characteristics of the target population, and the effects of different training approaches to determine whether and how to address the student/Soldier population. Similarly, the trainer should understand these factors in order to adapt the training to individual differences in the Soldier audience to make the learning process more meaningful, efficient, and effective. The trainer must also have the ability to detect important differences in individuals that could impact the learning process (Corno & Snow, 1986; Gagné & Briggs, 1979).

Involve trainers in the design stages of new equipment. The concept of involving trainers in the design of military equipment is not new. It is an essential part of the MANPRINT (manpower and personnel integration) process (DA, 1990). When the Army begins the selection and design process for new equipment, it must get trainers involved in that process as early as possible and keep them included throughout. By doing this, trainers can help impact the effectiveness of the system and suggest design ideas that will reduce the total training burden for Soldiers. For example, if the equipment involves computer systems, the training burden can be reduced if trainers work with system designers to determine how the system can have built-in test procedures, self-calibration procedures for weaponry, and/or intuitive interfaces. Another example is that new optics and sights are often developed for small arms. Designing different optics and sights so they are calibrated and/or zeroed in the same way will make it easier for Soldiers to remember what to do and easier for a trainer to explain what is required with a new optic or sight. Often a manufacturer is only aware of its own sight/optic, and thus not in a position to determine whether a procedure is consistent with other sights and optics. But trainers are aware of all Soldier equipment, and can therefore aid equipment designers in such design decisions.

If a trainer can influence a material developer to take advantage of the inherent capabilities offered in a computer system, the amount and type of training that might be required could be significantly impacted. A case in point is having the system perform steps and functions that currently the Soldier must learn and perform. For example, currently, in order to submit a call for fire, a Soldier requires training to learn radio procedures, how to use a compass to determine an azimuth, how to estimate distance or to determine map grid coordinates, and know the complete information elements required by the firing unit. By integrating the call for fire message with other capabilities of the computer system, it could be possible to automate most of the call for fire. A global positioning system (GPS) could provide the Soldier location, a laser range finder could locate the target, and a target description could be provided via digital photography, thus leaving only the effects on target as a decision factor for the Soldier. Training would then consist merely of teaching the Soldier how to use the computer-based system to help him call for artillery or other indirect fires on an enemy target.

In addition to new equipment, various training media and devices are developed, either in conjunction with the development of new items of equipment or independently of new equipment. These media vary from constructive simulations to assist with and facilitate training, to games for training leader skills and decision-making, to devices that facilitate the training of rifle marksmanship/gunnery skills. Trainers must be involved in these development processes as well to ensure appropriate principles of training are incorporated and the critical tasks are trained and assessed.

From new equipment to training devices, subject matter experts (SMEs) should be consulted and used. These SMEs can ensure that current doctrinal information and procedures are included in the design and that correct military terminology is used accurately. They can also suggest other potential uses and benefits of the system that might not be recognized by the equipment developer. For example, if a computer-based system gathers and tracks information on Soldier performance, perhaps the information could be tailored for input to an AAR capability that the trainer can use with the Soldier.

Identifying and selecting the SME can be crucial to the success of the project. The person needs to represent the input from various potential users and skill levels. In addition, this person must be knowledgeable of lessons from real-world operations so these can be incorporated in the design process. The SME must be available to support the effort through an appropriate transition point; you do not want the SME to leave the program at an inopportune time. Ideally, these SMEs would become the training developers and even possibly the trainers as the new equipment or concept is fielded to Army units.

Plan for and use a mix of instructional media and techniques. Typically a single instructional medium or technique provides only part-task training. In fact, the statement has been made that only combat provides full-task training. A mix of instructional media and techniques, appropriately designed and sequenced, will generally lead to more complete task training and a higher level of proficiency than a single medium or technique. The best mix of media and techniques and their sequence depends on the tasks and skills to be trained. Training research is the best way to determine the mix and sequence, but it is frequently not done. Such research is difficult to execute, and often decisions must be made without the benefit of empirical data.

Despite the rush to use simulations and advanced technology for training, some skills and tasks are best introduced and trained initially using the instructor-led classroom mode, with the instructor applying a mix of instructional media and techniques. Classroom instruction facilitated by an instructor can help Soldiers get started in learning a new system or skill. This is especially true when training includes not just system operation, but also the employment techniques for such a system. Once the Soldier learns the basic operation of a system or new skill, the instructor can present situational exercises that place Soldiers in real-world representative conditions and allow them to practice newly learned skills. After Soldiers have acquired sufficient skills, the trainer can add training media such as ICW and even simulations, where available. For example, an instructor might start with a classroom presentation introducing the capabilities of a digital system and explain how it can be used to facilitate job accomplishment. This could be followed by ICW where the Soldier learns and practices system operation at his own pace. The next step might be participation in a simulation exercise whereby the Soldier would actually use and employ the system to assist in accomplishing a typical operational mission.

When instructors might not be available or when use of the actual equipment or training devices/simulations is not possible, ICW can be an effective training medium to provide introductory system information to new users, and to enhance and/or sustain a Soldier's knowledge and understanding. With new users, the instructional designer should attempt to identify the major issues and questions that might arise during the initial stages of learning. As much as feasible the ICW should contain sufficient detail to address these anticipated issues so the learner can start training with a solid foundation of knowledge on the system. In many cases ICW can be very useful when the system is mature, since issues and questions from previous training can assist in determining what needs to be included in the ICW material. Also, when Soldiers are required to sustain or refresh their training proficiency, ICW that includes advanced material and content can be a cost effective means to augment unit instruction, especially when instructors are not readily available. These different applications of ICW imply that the content, and perhaps the design of the ICW as well, should vary in order to match the stage of learning/proficiency of the Soldier.

Integrating simulations into courses of instruction can provide benefits not achieved in traditional instructor-led classrooms. Simulations are usually best used to hone the skills of trained personnel. For example, training tactics, techniques, and procedures (TTP) to leaders might begin with an instructor-led discussion on doctrinal principles. Soldier interaction and experience would be integrated into the discussion. As Soldiers learn the doctrinal information and gain ideas from others' experiences, a video of an historical situation might be viewed and then analyzed. As Soldiers' expertise improves, Soldiers could then be placed in roles in a simulation where they are required to plan operations and respond to tactical situations or solve problems using the knowledge they have acquired. The instructor and other Soldiers could observe and critique the performance and subsequent outcome from the simulation. In this manner, Soldiers receive feedback on their performance from the simulation and from other Soldiers, while applying skills and knowledge in an increasingly more advanced situation.

Design training concurrent with new system, but develop training when most appropriate. The Army goal has long been to design and develop training systems and programs concurrently with new equipment design and development. The intent is to have TADSS, where appropriate, and programs of instruction delivered to the user at the same time the new system is delivered. While this is an admirable intent, it can be an extremely costly and cumbersome endeavor, as well as difficult to achieve. This goal is seldom achieved due to resource priorities.

In general, an instructor-led or hands-on training program is the best training approach when new equipment is under development and is not yet fully mature. The parallel development of TADSS and ICW for new and immature systems can lead to inefficient use of time, dollars, and other resources. System functionality, displays, operational capability, etc. frequently change or are modified during development. This causes training developers to continually revisit their design and development efforts to ensure their work is consistent with the most current actual equipment system. While it is true that ICW can be developed for web delivery and make a maximum use of templates to facilitate rapid updates, new, immature equipment systems change so rapidly that it is nearly impossible to keep up with the changes.

For new equipment that is evolving, our experiences indicate that instructor-led, hands-on training allows the training developer to determine which training media and/or TADSS might be most appropriate. Soldier reactions and their performance provide valuable insights regarding the most effective training media. Consequently, once the design and functionality of the equipment are stabilized, then more resource intensive training capabilities can be developed.

Select the appropriate training media and delivery methods for the intended task and audience. As most trainers recognize, various training media offer distinct advantages and disadvantages. To make a valid determination of the best methods of training delivery, developers must place themselves in the perspective of the intended audience, in the context of what is to be trained, know which skills are actually trained well by different media, and be aware of the results from relevant training research. For example just because a block of training can be delivered in a specific medium, such as web-based ICW, this might not be the optimum solution. Some tasks are simple enough to learn with minimal instruction so the expenditure of valuable resources to design, develop, and deliver the training through a sophisticated medium is not worthwhile. To meet more complex training requirements, a blend of media is usually appropriate, as discussed previously in this report.

Web-based delivery has the potential to get the training product to the maximum number of individuals with the least amount of resource expenditure (McArthur & Lewis, 1998). As a rule, no travel is required, instructor contact is not necessary, special training facilities are not needed, etc. However, the target audience and its ability to access the Internet must be considered. If the intended audience does not have the requisite access (e.g., appropriate computers, network connection), then this is not a viable delivery method. In many locations, Army installations and organizations are constructing new classrooms with advanced computers and high-speed network connectivity to provide a means for Soldiers to access web-based training material.

Besides dedicated modern classrooms with advanced computers and high-speed network connectivity, creative solutions are available to overcome Internet network access and bandwidth shortfalls. Soldiers deployed in support of Operation Enduring Freedom (OEF) in Afghanistan and Operation Iraqi Freedom (OIF) did not have sufficient bandwidth to access selected ICW material. A recent experimental effort by a TRADOC school showed that the material could be delivered across the Internet, but was also offered in Internet-based, downloadable files. This allowed a supervisor to download files to create a set of compact discs (CDs) to be used off-line on stand-alone computers. According to verbal feedback from the TRADOC proponent school, leaders indicated that having the CDs available proved to be an invaluable means for providing this training material to deployed units.

Other methods to deliver instruction, such as video-conferencing, have been successful in some circumstances. Depending on the training material being presented, using one-way video conferencing, where the instructor is the one on video, might only be marginally successful. A better use of video could be close-ups of the demonstrations or animated drawings of the steps performed by the instructor. In the case of two-way video, videography of students performing hands-on tasks would allow a distant instructor or assistant instructor the ability to watch the student perform a hands-on task and permit immediate feedback.

Establish clear, measurable, and attainable objectives for the skills that must be acquired from the training. While this point is often made, the full meaning of what this requires can be easily overlooked. Each training objective must be clearly stated. The Soldiers must be able to recognize when they have attained the objective, that is, acquired the requisite knowledge or skill from the training. In addition, the objective must be attainable by the Soldier, especially under the conditions where it must be performed. Establishing unrealistic objectives is not useful for trainers and can be extremely frustrating to Soldiers.

In some instances, such as training cognitive skills for digital systems or for educational purposes in lieu of training, clearly defined objectives might be more difficult to articulate. However, wherever possible, a clear measurable objective should still be identified for the Soldier. For example, the intent of the training might be to introduce the fundamental principles for operating a digital system, like an overview of how the menus or toolbars function. This knowledge would then be directly applicable and transferable to subsequent training on specific aspects of the system that rely on the use of the menus or toolbars. In these general situations the training objective might be tied to applying the menu and toolbar functionality to a specific set of screens or operations. Another example is evidenced when the intent is to train leaders to be flexible and adaptable. Defining specific measures of leader flexibility and adaptability can be extremely elusive, especially when varied responses from leaders are anticipated and encouraged. A precise articulation of this objective with a measurable criterion will be difficult. The trainer's challenge is to identify and develop measures of Soldier performance that indicate the required knowledge or skill has been attained.

Incorporate recent lessons from combat leaders. During the 2004 Infantry Commanders' Conference, several presenters, often senior military leaders, offered suggestions concerning a variety of training topics. Most of these were a direct result of seeing Soldier performance in OIF and/or OEF. They are offered here as additional insights to be considered in the ISD process when designing, developing, and implementing training. Major points extracted from the presentations are given in next four paragraphs; they are not quotations.

- Training courses need to be modified so they are more relevant to the needs of the Army. During peacetime, general leadership skills might be sufficient, but with an Army at war, the focus of all training needs to be on preparing Soldiers and leaders for combat. For example, leadership courses should train and emphasize "adaptability." Do not spend precious time on "folding socks properly" and wall locker inspections; use the available time for combat-related situational training that will make Soldiers more effective leaders in the contemporary operating environment.

- Wherever possible, training needs to be conducted in a realistic environment that replicates the expected conditions of where the task will actually be performed. This includes not only the physical characteristics of disparate areas and situations, but also integrating different language and cultural aspects for varying regions of the world.

- Given the complexity of the battlefield and the vast amount of digital information available even to lower level leaders, more junior Soldiers are expected to perform tasks formerly only accomplished by upper level leaders. Also, Soldiers and small teams are finding themselves in locations separated further from parent organizations than has typically occurred in prior warfare. This means that more Soldiers are expected to be able to perform more tasks, and many of those tasks might be complex. The lesson here is that one training package does not routinely suffice for the myriad of training requirements. In many cases, similar but distinctly different, training materials must be developed for specific or specialized duty positions and possibly even for different types of missions. This requirement must be considered in the ISD analysis process.

- The contemporary operating environment can be very complex in terms of terrain, enemy, mission, troops available, and other factors. Typical Army range facilities and training areas are not necessarily representative of these conditions. Training developers must be mindful of this new operating area and be creative in designing training that places Soldiers in these demanding conditions. A specific area of stability and support operations (SASO) introduces new challenges to leaders and Soldiers. Situations in SASO can be so varied that the ISD process must consider a multitude of circumstances in the tasks to be trained as well as the anticipated involvement of the training audience. For example, SASO nearly always require face-to-face interaction between leaders and subordinates to ensure the commander's intent is properly and fully understood. This places a high demand on trainers to ensure a sufficient trainer-to-Soldier ratio is maintained. SASO also require some new skills in addition to varied conditions under which the skills might have originally been learned. Examples include the requirement for Soldiers at all levels, not just senior leaders, to interact closely with local civilians and the media. Navigating in an urban area, along streets and alleyways, and making your way through partially destroyed buildings is quite different from traversing wooded terrain to locate a point on the ground. Trainers should explore enhancements to the training environment that include situations that require rapid "shoot - no shoot" decisions, add clutter and hazards to the training area rather than firing on relatively clean ranges, and provide obscuration on the battlefield with smoke from fires or other cover and concealment capabilities being experienced in OIF and OEF.

The bottom line is that designing and developing effective training has become more difficult. The ISD process is still a sound approach. However, the tasks to be trained have increased and changed. More significantly, the conditions under which the tasks need to be trained have become extremely complex and varied. Training designers and developers must conduct thorough analyses, based on timely feedback from real world activities, to ensure that training is relevant and appropriate.

Live Training Lessons

The topics on live training are listed in Table 2. The first lesson examines the crawl-walk-run approach to training many tasks. This is followed by other lessons on general approaches to training. Lastly, lessons on more specific training contexts (e.g., digital skills, new equipment training) are presented.

Table 2
Live Training Lessons

• Follow a proven sequence to maximize success for the Soldier to learn • Standardize and provide details for critical practical exercises (PEs), but allow flexibility • Allow Soldiers time to practice new skills • Train tasks within the context in which they will be executed and relate to commonly understood practices and information when possible • Train tasks in specific steps only when specific steps are required and train multiple ways to accomplish a task when they exist • Use a "building block" approach in designing and presenting training • Address individual task skills and how they fit collectively • Develop new blocks of instruction when Soldiers should learn new habits • Assess prerequisite knowledge and skills before starting new training • Use training devices/media/facilities that provide immediate and detailed/appropriate feedback wherever possible • Ensure the trainer is able to observe Soldier actions when the "process" is important • Identify the core cues, skills and information that will facilitate transfer; recognize when transfer will not necessarily occur. • Provide input to represent the environment when training digital systems • Use a problem-solving, learner-centric (constructivist) approach where appropriate • Expand New Equipment Training Team (NETT) responsibilities and leave-behind materials

Follow a proven sequence to maximize success for the Soldier to learn. For years, the military has espoused the crawl-walk-run philosophy of training hands-on tasks. In accordance with this approach, when a task is trained initially, execute it slowly then increase the intensity to accomplish the task in the manner and to the standard in which it is required according to established manuals. While this approach is typically adequate, it may not be sufficient for some tasks. For complex hands-on tasks, the expanded procedure shown in Figure 2 might be a useful approach. While crawl-walk-run is still an integral part of the training, this expanded approach better prepares the Soldier for hands-on training. A related lesson discusses the importance of trainers knowing different training approaches and knowing when to use each approach. This is only one approach to be considered for use, when it is appropriate.

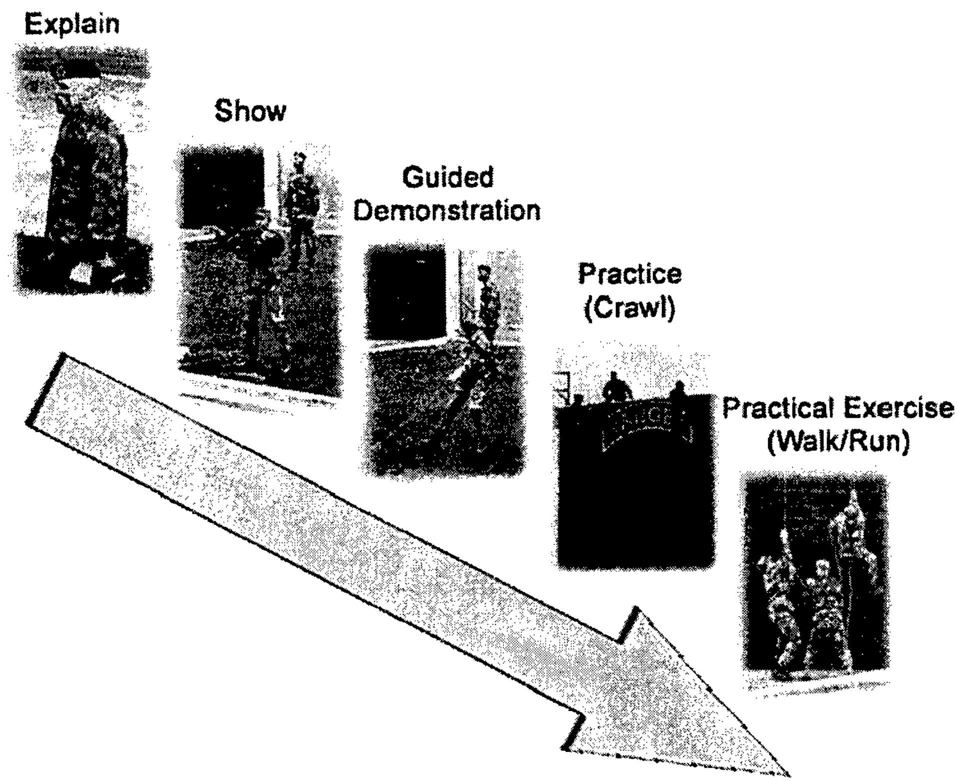

Figure 2. Sequence for training many tasks.

This expanded approach involves an "explain – show – guided demonstration – practice – practical exercise (PE)" sequence. This is not intended to be a lock-step procedure, but rather a sequence to consider in executing the training. For example, the depth of the up-front training explanation will vary, depending on the task to be trained and the overall training technique being used. With unskilled Soldiers and a complex task you might need to provide a detailed explanation in order for them to grasp the material before proceeding. On the other hand, with more experienced Soldiers or when the trainer is using a problem-solving approach (discussed later in this report), a short explanation to place the Soldiers in the proper context might be all that is required. Also, the trainer might not conduct each step in a fixed sequence. For example, you might explain something to the Soldiers then allow them to explore the material or attempt the task with only this information. We have learned through our research on exploratory training that Soldiers typically do not learn complex tasks very well on their own, so the rest of the training sequence is important to the learning process. When the Soldier is not able to accomplish the task or has had inadequate time to explore the material, the trainer could show Soldiers the correct way to accomplish the task. In some situations, this might be more meaningful since the Soldiers will have already attempted the task and experienced the difficulties that are involved.

Explain is done using the actual system or annotated images depicting the task to be accomplished. The trainer should explain for the final outcome, what "right looks like," and the overall process to accomplish the task. This places the task in context and provides the Soldier a framework for the specific steps, rather than launching into a detailed list of steps. For example, if you want Soldiers to prepare an operation overlay, you would want them to know initially that the end product will be an overlay with multiple symbols that depict the plan for the operation. A trainer would explain the overall purpose of the overlay, the major items on an overlay, and the general process that will be followed in constructing the overlay. Providing this explanation also allows Soldiers to maintain a perspective of how far along they are in task accomplishment.

Show is done using the actual system or simulated system to show what and how to do each step. For the initial showing, it might be best to show only one sequence of steps, even when multiple sequences might be acceptable. The trainer must gauge the learning capacity and military background of the audience and use discretion. Initially, it is usually more important that Soldiers learn a single way to accomplish a task, rather than all the ways that are possible. During the show phase, an instructor should take time to allow the Soldiers to observe and understand every step. This might entail repeating the step so Soldiers can clearly visualize what needs to be done. Progressing through the procedure the correct way enables Soldiers to see what right looks like. The Soldiers are merely observing the instructor and are not actually doing anything themselves. Full attention is on watching and listening.

A guided demonstration is the next step after the trainer has shown the correct sequence for task accomplishment. In a guided demonstration, the trainer talks the Soldiers through each step of the task. In some cases, the trainer and Soldiers may be performing each step simultaneously. This is an ideal opportunity to place the task into an operational context so Soldiers can assimilate the task in the manner that it might be performed in an operational setting. Here the Soldiers can now grasp the significance of the steps because they must execute the steps. Examples are using the keyboard on a digital system and then seeing what display is generated, or showing how to establish a stable firing position. The trainer should show the correct/proper steps, and not introduce incorrect steps, even if it is clearly stated, "Do not do it this way." The trainer can introduce more details about each step in this process. As noted by Cronbach (1963), having an individual discover a psychomotor response for himself/herself is a poor teaching technique, compared to demonstrating the action he/she should perform.

It is important to allow Soldiers time to practice the steps of the task on their own, while the steps are fresh in their minds. A Soldier might seem to understand and comprehend the steps for task accomplishment, but this appearance can be misleading. Experience has shown that the Soldiers might believe they understand how to accomplish a task, but when they actually attempt to accomplish it they recognize some aspects of the task that might not have been completely obvious to them while performing it in a guided demonstration. The practice might start as a crawl, where the trainer assists as needed while the Soldiers execute the steps. As proficiency increases, the trainer should allow Soldiers to move more quickly until the task is learned. At this point, it is not necessary that Soldiers master the task to a specified proficiency level, but that they know how to and can accomplish the task. As Soldiers practice the task, they could do some steps incorrectly. Therefore, it is during this initial practice period when the trainer will probably want to introduce some of the wrong/incorrect steps, their resultant outcomes, and how to overcome any adverse consequences. Soldiers will need to know how to correct their own errors. This practice stage allows Soldiers to learn the steps, not necessarily to apply the skill in accomplishing an exercise or a larger task, which is addressed next.

It is during the practical exercises where task accomplishment within the operational and contextual environment should be inculcated. Develop and present realistic situations that allow Soldiers to recognize when and what needs to be accomplished, why it needs to be done, and that require them to execute the task to produce the required results. These exercises should be varied and increase in complexity (the walk and run phases), until Soldiers can demonstrate task performance at the required proficiency level. Exercises should also be constructed with a "building block" approach, incorporating other previously learned tasks.

Standardize and provide details for critical practical exercises (PEs), but allow flexibility. PEs present an excellent means to allow Soldiers an opportunity to practice hands-on skills and hone their capabilities. PEs that focus on basic or foundation skills should be standardized to insure the basics are trained and mastered. PEs also provide a trainer the ability to assess Soldier performance and to identify areas requiring further training. For assessment, PEs must be standard, otherwise performance results will not be comparable across Soldiers. A caveat is made to the lesson learned stated here. Flexibility in PEs used for training is needed and desired under some circumstances, to allow trainers to further challenge Soldiers, to allow trainers to use their creativity, and to continue to motivate Soldiers.

Generally as the complexity of the training tasks increases or when systems have tasks that can be accomplished by employing different actions, the actual tasks to be assessed and evaluated in a PE must be articulated in some detail. Where varied and multiple actions lead to the same successful task execution, the PE must allow for this flexibility unless there is a special training reason to select only one "proper" way to accomplish the task.

Training on digital systems illustrates the need for flexibility in PEs, as the operational software itself is often flexible. Trainers must recognize when more than one approach to accomplishing a task can be used. The training could, perhaps, have Soldiers do the task more than one way to achieve the desired flexibility. For example, a typical PE might stipulate that the Soldier is to place a symbol on a map. In some digital systems, the Soldier might be able to select the symbol to be placed and then designate the location on the map where it is to be placed. In other systems, the location of the symbol might need to be stipulated before choosing the symbol. For another system, the sequence of these two steps might not make any difference. The step sequence should be emphasized only if it is essential or necessary for task accomplishment.

However, standardization must exist and details must be provided for the PE to ensure that Soldiers are developing the same degree of expertise. Continuing with the symbol example, the PE must provide details that describe what type of symbol to use (some are more complex to draw and to locate in menus or libraries than others); where the symbol is to be located (to ensure correct placement and orientation); the context in which the symbol must be placed (this impacts symbol size and other symbol characteristics); and so on. We observed that when each trainer is left to determine these details, some Soldiers are subjected to more complex PEs than other Soldiers, performance results are not comparable, and resultant feedback is not as useful for evaluating the effectiveness of the training that was presented.

Allow Soldiers time to practice new skills. A basic psychological principle is that performance improves with practice (Cronbach, 1963). Fitts (1964) indicated that it is rare to achieve an asymptote on performance with perceptual motor skills. Even the performance of highly skilled individuals improves slowly over a long period of time. Unfortunately, despite this well-known impact of practice on performance, training time for Soldiers is often limited, both in the institution and in the unit. It is probably safe to conclude that often military trainers underestimate the length of time required to achieve a high level of proficiency on many tasks, e.g., marksmanship, moving with night vision goggles, driving, and operating digital systems. When collective tasks are considered, proficiency depends not only on individual skills, but also on the appropriate interactions among individuals. Development of these small-unit skills requires even more training time.

We observed that even though Soldiers might appear to have learned a particular task, as they have the opportunity to actually practice the skill, they discover nuances to task accomplishment that might not have registered with them during the earlier periods of training. Especially as tasks are presented in context, Soldiers become more aware of the reasons and importance of certain steps. They recognize similarities with other tasks; they assimilate interactions and they form means to remember the required steps. They increase awareness of other circumstances or situations in which the task takes on importance; and they become more comfortable in executing the task. As the adage says, "Practice makes perfect" and practice allows for the fine-tuning of skills. Allowing practice time and requiring task repetition helps cement the information and procedures for future recall.

This concept takes on more importance as the complexity of the task increases, as the required interaction between tasks becomes more complicated, and as the conditions of combat change, requiring Soldiers to be more flexible and proficient. For example, Soldiers first learn the basic skills required to mount and make adjustments to night vision goggles. Additionally the practice sessions might include adjusting the goggles to view objects at different distances, in varying backgrounds (thick vegetation vice relatively open area), and under a variety of light conditions (ambient outside light vice inside buildings). These sessions enable Soldiers to learn how to adjust their goggles to provide the optimum view under varying conditions. These learning experiences will then transfer to using the goggles in an operational environment. As an added complexity, some new systems employ a helmet-mounted device for viewing tactical information and maintaining situational awareness. Using the night vision goggles in combination with this other display device can introduce new complexities (when to use each device or how to use them simultaneously). While Soldiers might have preconceived ideas of how best to use this equipment, actual practice under different conditions in realistic environments is the best means to accomplish this training.

Train tasks within the context in which they will be executed and relate to commonly understood practices and information when possible. This lesson illustrates some of the central tenets underlying the psychology of meaningful verbal learning (Ausubel, 1963). Under Ausubel's concept, "meaningful learning takes place if the learning task can be related in a nonarbitrary, substantive fashion to what the learner already knows, and if the learner adopts a corresponding learning set to do so" (p. 18). Thus learners must make an attempt to integrate new material into their own knowledge structure, but the material must have the potential to be integrated in a nonarbitrary fashion in the first place. A major challenge to the trainer is to present, organize, and translate the material in the appropriate manner for such meaningful learning to occur, keeping in mind the strong impact of the Soldier's existing cognitive structure on this learning process.

A common tendency is for trainers to impart new information or training material "in the abstract," which contradicts what is known about how to make new material meaningful. Avoiding this common tendency, by placing the materials, skills, and tasks in the context in which they will be executed is an instructional technique that makes the material potentially meaningful, rather than rote.

For example, in a digital system, the Soldier might learn which buttons to push and which menus to access on the graphic user interface (GUI) in order to obtain a selected display screen. The training objective of accessing the selected display screen would be accomplished. However, it is much more meaningful if the trainer explains when and why the Soldier would want to access that particular screen. These situations should be appropriate to the military experience of the target audience. In turn, when confronted with a real world situation, the Soldier is better prepared to decide what action to take or what screen to access. When learned in the operational context, the labels on buttons and/or menus in the GUI take on meaning from the context, which will spark memory cues to assist in recalling the proper actions or sequence of steps.

This lesson learned is not restricted to digital systems. Another example is learning how to adjust a sighting system to provide the best image. Thermal sights have many controls which must be adjusted appropriately to obtain a good image. Training can be conducted in the abstract, for example – "turn to the left and the image will be brighter." However, a more meaningful context would to train the adjustment procedures using real-world contexts similar to what the Soldier might encounter in combat, such as thermal images of vehicles, buildings in an urban operations site, and people at various distances. With this technique, Soldiers will learn proper adjustments as well as the thermal signatures of objects and materials, essential to target detection and identification in combat situations.

Although the example just cited put new tasks and skills in a military context to enhance learning, other contexts with which Soldiers are familiar can be used to make the material meaningful. For example, the purpose of some of the controls on thermal imaging sights could be related to how or why adjustments are made to obtain a clear image on a television set. In another situation, if the functions in a military digital/software system are similar to Microsoft® Windows, e-mail, or internet applications with which Soldiers are familiar (Singh & Dyer, 2001, 2002), these links could be made by the trainer. Training observations and experiments showed that Soldiers more readily learned to operate and understand how to use new system software when Microsoft® conventions were used or when an analogy could be made to Microsoft® conventions. Explaining steps and functions in relation to the software operations that Soldiers already understood made it easier for them to grasp the training material. Even though new systems use a variety of software applications and operating systems, if the trainer can explain system operation in relation to Microsoft® conventions, the learning burden for Soldiers could be diminished.

Another example is military radio communication procedures. Most Soldiers are familiar with commercial cell phones. Where applicable, trainers could use the Soldier knowledge and experience gained from regular voice communications with cell phones as a foundation for training military radio communication procedures. The key point is that when trainers relate new material to what Soldiers already know, whether it be a military or a non-military context, it will be easier to learn and to retain.

Train tasks in specific steps only when specific steps are required and train multiple ways to accomplish a task when they exist. Having familiarity with the situation in all guises provides the user more adaptability (Cronbach, 1963). It is important to isolate the essential elements in accomplishing a task. Yet introducing variability can provide more options when it comes to task execution. At times, military trainers, especially for lower ranking personnel, tend to structure the training of a task in a lock-step procedure, leaving the impression that there is only one way to accomplish the task. This technique is appropriate for initial learning of a task, where there is only a single way to perform the task, or even when one way is clearly the most efficient way to accomplish the task. However, with complex tasks there are usually multiple ways to accomplish the end state of the task. For example, for those who are familiar with Microsoft®, there are multiple ways for a person to copy and paste text between documents, not a single way. Likewise, military digital systems frequently offer multiple ways to successfully accomplish a task.

Training multiple ways to accomplish a task can be quite beneficial. Some Soldiers might better recall how to accomplish a task one way vice a different way based on their prior experiences or their method of recall. Also, in some situations, the single method to accomplish the task might not be readily available or even doable. In this case, the Soldier would still be able to accomplish the task using an alternate method. From another perspective, introducing or practicing the task in a tactical vignette or problem-solving situation promotes exploration of multiple ways to accomplish a task. Permitting Soldiers to share solutions provides an opportunity to share multiple paths to success. Therefore, unless one particular way is the only or most efficient way to accomplish a task, trainers should strive to present an array of task accomplishment options when they are available.

Use a "building block" approach in designing and presenting training. Few military tasks are conducted as stand-alone events; they are part of an overall scheme of mission accomplishment. It is not necessarily obvious how individual task/skill training should be sequenced, how much practice is necessary before progressing to new tasks, nor what training conditions best facilitate individual skill progression and retention and task understanding. Our training observations of digital systems showed the importance of applying a building-block approach to ensure development of expertise. The concept of learning hierarchies is not new (e.g., Gagné, 1965, 1985). The building block approach cited here refers, in most cases, to establishing building blocks between what are traditionally considered Soldier tasks. These tasks can reflect the same type of learning in Gagné's framework, for example multiple discriminations or concepts,

Some tasks must be accomplished before other tasks are possible. With this in mind, whenever possible, incorporate previously learned tasks into the exercises for new tasks. This procedure causes the Soldier to understand the dependencies among tasks, and also provides opportunities for reinforcing and practicing tasks.

Some tasks must be practiced repeatedly to ensure mastery, and this requirement should be incorporated in the training sequence. To reinforce this point, during training on digital systems, Soldiers did not retain all the information they received, even over a short period of two to three days. Given the sheer volume of procedures and information Soldiers must master with some systems, training should incorporate sufficient exercises and include other techniques that will facilitate the Soldier's ability to retain critical information and procedures. Some of these techniques include reducing the number of tasks by increasing the number of training blocks, regrouping some training to develop manageable size packages of material, and including mnemonic aids.

Another facet to this issue is to determine what these building blocks should be and the appropriate sequencing of these task building blocks. The importance of the learning sequence for training military tasks was stressed by Gagné as early as 1962. The trainer must ensure that the required core skills are identified. This, in itself, can be a demanding responsibility for new and complex tasks. Where possible, trainers should determine where transfer of learning is expected to occur. Only after the set of building blocks is identified can the trainer begin to assemble the training blocks into the highest payoff sequence. Realize that this building-block sequence is not necessarily obvious, particularly when some tasks or skills are not linked. Even though the trainer may know which skills/tasks support a higher-level skill/task, this information does not in and of itself indicate the sequence for training all the subordinate skills/tasks.

Address individual task skills and how they fit collectively. This lesson learned is an extension of the building block concept just presented. It applies to the integration of individual and collective skills. Just as very few tasks are conducted for a stand-alone purpose, most individual tasks are executed as a contributing portion of some collective task. With this in mind, the trainer should assemble building blocks in a sequence that reinforces the individual tasks being trained by integrating them into the appropriate collective context. Part of learning a task in context requires that the Soldier learn his own individual skill as well as how his individual role fits within the collective arena of overall mission accomplishment. By learning tasks in this manner, the Soldier becomes a more effective contributor to the team and is generally better able to support the requirements of the collective mission. The linkage to collective tasks should be covered when the task is initially introduced so the Soldier can grasp the big picture context. When PEs for individual tasks are conducted, the operational situations should link to collective tasks and overall unit (team) missions. Where possible, these practical exercises could be executed in conjunction with other groups of Soldiers practicing interrelated skills.

As an example of this lesson learned, consider constructing an operation overlay. An overlay is required to support a collective task, some type of military operation. Therefore, after training some basic individual tasks and skills in preparing an operation overlay, trainers can place the Soldiers in a collective situation where they must practice and apply the new skill in a collective setting – the way it will be done in an actual situation. Trainers can give the Soldiers a real mission and have them work as a team to construct the necessary operation overlay. When they have this accomplished, complexities in the form of branches and sequels to the operation that expand the overlay requirements can be added. This allows the trainer to introduce and train Soldiers on more individual tasks. At each appropriate opportunity, reinforce individual tasks by having Soldiers practice and execute them in a collective, real-world situation. If the individual tasks are organized to show how the system being trained contributes to success of the mission, a double benefit is obtained.

An unresolved issue that arose in our training research and observations is the sequencing of individual and collective task training. Although proficiency on some system-related individual tasks is required before some collective tasks can be performed, proficiency on all system-related individual tasks is not necessarily a requirement for all collective task training. With new systems should the training sequence be simply all individual tasks then collective tasks? Most training on new systems proceeds in this manner, from all individual to all collective, but it remains an empirical question whether it is the most effective or efficient approach.

Another training option was proposed in the process of our research. This alternative approach has the potential for increasing the learning curve of individual and collective tasks, while reducing the training burden at any single time and providing a training environment that sustains skills through repetition and integration. This option reflected the following sequence: train on some individual tasks followed by related collective task training, then include additional individual task training in a different domain followed by related collective task training in this second domain. Then collective tasks that integrate the two domains could then be integrated. For example, with a new Soldier system you might focus on individual navigation/map reading tasks then apply these skills in a collective land navigation task. You might then focus on individual communication tasks, followed by collective communication tasks. Next you might have Soldiers conduct an exercise that integrates both their individual and collective navigation and communication skills. As stated by Cronbach (1963), instruction can be deliberately changed from what might be considered the natural sequence in order to speed up learning.

Develop new blocks of instruction when Soldiers should learn new habits. When use of a new system means that Soldiers must change habits to exploit its capabilities, but yet they can still operate (e.g., communicate, move) as they have in the past, a different training approach may be needed. First, you may need to motivate Soldiers to use the equipment by having them participate in specially-designed exercises that show them the benefits of the equipment – they can do a task faster, can accomplish a difficult task more easily, etc. Then the appropriate building blocks and exercises must be developed that facilitate behavior change and allow Soldiers to integrate the new skills into their repertoire. Sufficient practice must be given so Soldiers gain the required confidence, and the new skills become automatic when needed.

A prime example of this is when Soldiers must learn how to optimally use a helmet mounted display (HMD) while conducting dismounted movement and navigation. Currently, dismounted Soldiers do not wear an HMD. Soldiers generally have an unobstructed view, with the exception of using night vision devices during periods of limited visibility. When navigating, they use a map and compass to determine location and direction of movement. At times they must stop and examine the map to confirm accurate position information. Soldiers are accustomed to having a full field of vision and have typically formed habits of keeping pace counts, holding a compass while moving, and stopping periodically to conduct a map check. Taking advantage of an HMD requires Soldiers to change many of these habits. They must initially learn where to position the HMD so it minimizes obstructions to scanning the environment, yet the display is still clearly viewable. Soldiers must acquire confidence in the information displayed on the HMD so they do not stare at it while moving, but rather learn to check it as they would a rear view mirror while driving.

The display on the HMD can provide a map and the Soldier's location as indicated by grid coordinates and a visible icon. Soldiers can also see locations of other persons. And they can see overlays which may indicate the route to the objective, location of the objective, check points, rally points, and other critical graphic control measures. Thus by viewing the HMD, the Soldier can quickly know where he is, the direction he is moving, where other Soldiers are located, his own position relative to others, and his position relative to critical terrain features and unit control measures. The old habits of using a compass, stopping to conduct map checks, having to maintain visual contact of others within your unit are no longer required. Uncertainty is reduced.

With this example, even though the display technology has advantages, new habits must be formed. Explaining how the new technology allows Soldiers to do things differently is a start point. Yet explanations are insufficient. Soldiers must practice to become proficient and confident in using and changing display information. Exercises must be developed that require Soldiers to use the display; exercises where current procedures and techniques are not as effective or are ineffective. For example, day and night exercises need to be created that require Soldiers to coordinate their movements with others who are not in their visual line of sight, but whose locations can be seen in the HMD. Soldiers need practice in varying conditions to enable them to determine when, how often, and under which circumstances to glance at the display when moving, but not become overly dependent on it. They must gain confidence that the display depicts the actual locations of others so visual contact is not necessary. Exercises should be developed that enable Soldiers to determine who they should select to show in their display as well as require them to change the individuals shown in their display. Unit leaders may find it necessary to develop standing operating procedures for displays to maintain personnel accountability. Such new procedures, behaviors, and activities should be emphasized in training.

As we observed, these new skills were not gained automatically, but were facilitated by specific training exercises.

There is a pitfall, however, that must be avoided with some new technologies. Technology can make some tasks much easier to perform, saving training time and actual task execution time. However, the trainer must be cognizant of the point that technology does not eliminate the need for the basics involved in many tasks and these must be included in the training blocks. Using the HMD example, while position location and map plotting are simplified, Soldiers should still know basic skills such as determining cardinal directions (north, south, east, and west) and interpreting map symbols. These skills are necessary in interpreting map displays and using them effectively. In addition, Soldiers must still be able to function as they have in the past in case systems go down.

Assess prerequisite knowledge and skills before starting new training. Administering a pretest can be an effective means to determine the entry level of skills and knowledge for Soldiers. Pretests, properly designed, can assist in determining what tasks need to be trained, and possibly in identifying how best to train them. When preparing to train on a new piece of equipment or in a new skill area, developing a comprehensive pretest might be a difficult undertaking. Regardless, the trainer must be able to identify any weaknesses or gaps in the Soldiers' entry-level proficiency before commencing training on the new system or area.

The consequence of overlooking this step is that the prerequisite knowledge and skills must be trained regardless, as was confirmed during training observations of new systems and equipment. The Soldiers had to receive remedial training as they were not able to accomplish the new target tasks otherwise. This took valuable time away from the primary purpose of the training. Training can be made more efficient and effective if training plans accommodate potential weaknesses in the Soldier's initial repertoire of skills.

Several examples of this lesson are provided. For example, digital systems often provide the capability to view map displays. While learning to manipulate the digital system to view the map display is very important, unless the Soldier understands what the map depicts (terrain features, grid coordinates, etc.), the display is nothing more than a picture. Similarly, before Soldiers can create a message or operations order in a digital system, they must know what information should be contained in the message or order. Knowing how to complete an automated form can prove beneficial, but if the content of the form does not contain accurate and meaningful information then it is not useful.

Pretests are applicable to physical abilities and psychomotor skills as well, not just mental skills and knowledge. Before training a Soldier in advanced marksmanship skills or how to engage targets with a new optic or sight, trainers should ensure that the Soldier possesses the basic prerequisite marksmanship skills that will be required to properly accomplish the new task.

Use training devices/media/facilities that provide immediate and detailed/appropriate feedback wherever possible. A well-established tenet of learning psychology is that feedback or knowledge of results is probably the most important variable controlling performance and learning (Cronbach, 1963), even though feedback does not necessarily have to be provided on every practice trial to be effective (Proctor & Dutta, 1995). This lesson bears emphasis in light of the expanded use of technologies in training. Computers are prevalent and they provide an excellent means to capture information, track performance, and even provide automated evaluation feedback. Incorporating this capability into the training environment offers several advantages, to include more efficient training. When Soldiers have the opportunity to practice a new skill and receive real-time feedback on performance, they can more quickly assimilate what they are doing correctly and assess the impacts of modifying their actions or behavior. This allows Soldiers to use training time more efficiently, explore implications when they try something different, and better cement the proper techniques into their knowledge base. If a Soldier recognizes a performance problem from the rapid feedback, he can modify behavior or make the necessary correction without delay. Likewise, by exploring other ways to perform a task, the Soldier can gain a better understanding of his skills and performance, and how best to accomplish a task under varied circumstances and conditions.

A prime example of this feedback capability is the Location of Miss and Hit (LOMAH) firing range technology. This particular type of firing range has sensors around the target area that detect the path and exact location of the bullet in reference to the target. This information is recorded and can be immediately displayed at the firing point for the trainer and firer to see the results. This eliminates estimating where the bullet impacted, and if it missed the target, in what direction and by how much. This allows the Soldier to make appropriate sight adjustments or modify his firing technique in order to properly engage targets. The Soldier can then adjust his behavior and immediately determine the impact on marksmanship performance. When the appropriate adjustments are made, this type of feedback was shown immediately lead to increased confidence as well improved performance.

A LOMAH system typically provides automated assessments that assist the trainer and firer in knowing what sight adjustments to make on the weapon during the zeroing process. There are some potential hazards to this timely feedback. It is possible for Soldiers to improperly compensate for a target miss. For example, inexperienced Soldiers might tend to "chase" the bullet around the target with various sight adjustments when the cause of the problem is an unstable firing position or jerking the trigger. In general, trainers must ensure that appropriate adjustments are made to ensure proper performance.

Good trainers were observed to use the automated feedback on different marksmanship training devices and systems to diagnosis learning problems effectively. Just providing automated feedback to the Soldier was insufficient to improve the performance of inexperienced Soldiers. The advantages of such feedback were realized through trainers. Rarely will automated systems replace the full knowledge and experience of skilled trainers.

Good performance feedback is not solely dependent on computer technologies. Even low-technology devices and media can provide detailed and appropriate feedback. A useful technique that was observed was videotaping Soldier performance during task execution. The Soldier can then view his own performance, and even allow other Soldiers to view and provide an assessment. This permits the Solder to conduct a self-assessment and actually see what he might be doing incorrectly. Peer review also provides learning for the specified individual as well as the observers. Another non-computerized device is the use of paint ball projectiles when conducting force-on-force tactical training. Soldiers know instantly if they have been hit, both from the visual appearance of the paint as well as the feel from the impact of the round. In addition, paint color assists in determining if the shot was from the enemy or was misdirected friendly fire.

Trainers should be cognizant that real-time, detailed feedback to Soldiers provides distinct advantages. Systems that provide automated feedback can aid the trainer in assessing performance and in assisting the Soldiers. Often, these systems provide feedback on Soldier behavior that would be very difficult to obtain otherwise or may not be directly observable to the trainer. Being innovative in searching out means to incorporate devices and technologies that provide automated feedback into the training design offers immediate assessment and even recommended corrections. While these technologies are extremely beneficial, training development should not depend on them to replace or denigrate the role of the trainer. These devices/media/facilities are training enablers, not a substitute for qualified trainers with experience.

Ensure the trainer is able to observe Soldier actions when the task process is important. This lesson is a corollary of the prior one on feedback. With many digital systems it is difficult, if not impossible, for the trainer to observe the actions or steps that a Soldier performs to accomplish a task when using the operational system. As such the trainer cannot provide any feedback. This is especially the case when the system is equipped with a helmet-mounted display or has a limited viewing capability, such as displays in confined vehicle compartments. In some cases, successful task accomplishment is adequate feedback for the training. However, in other cases, the process, steps and actions, used to accomplish the task are extremely important, particularly when the task is the foundation for many functions or is executed frequently. The trainer needs the ability, through some monitoring device, to observe what the Soldier is doing for each step of a process, not to just evaluate the final outcome. As planned with some new systems, feedback can be facilitated via a device attached to the digital system that provides an alternate viewing capability. When conducting training in a classroom on a desktop computer, the trainer can usually observe the Soldier's actions.

Two caveats must be added here. For some operational systems, the capability to monitor Soldier actions must be incorporated in the system design, as modifying the equipment later to provide this capability may not be possible or may be too costly. Secondly, even within a classroom, a trainer, at any given point in time, can typically monitor the performance of only a limited number of Soldiers.

Identify the core cues, skills and information that will facilitate transfer; recognize when transfer will not necessarily occur. Predicting when training on one task or skill will transfer to another is difficult, as the degree of transfer is dependent on many factors (Cormier, 1987). It has been well-established that concepts and principles are retained longer than steps or facts that must be memorized (Adams, 1967; Ausubel, 1963). These factors imply that training can be facilitated by identifying core concepts that allow maximum transfer and general understanding (thereby reducing the requirement to train all tasks initially). Transfer is also affected by the overlap in the stimulus attributes or cues or features to the transfer situation. On the other hand, there may be little transfer when behavior has been automatized through extended practice to specific cues, particularly when the cues or critical elements in the transfer situation differ in some way (Cormier, 1987). The examples given here illustrate situations where we have observed transfer as well as situations where transfer did not occur.

The authors have observed Soldiers trained to boresight different sights and devices to their weapon. The basic concept underlying why boresighting works is the same for all devices. Explaining this to Soldiers, instead of requiring them to memorize steps, can give them the capability to solve an unexpected boresight problem and will help them independently determine the appropriate boresighting procedures and/or sequence if they are forgotten.

Similarly, we have observed that most individuals do not need to learn every aspect of a digital system or software interface. There is often a core set of tasks essential to operation and troubleshooting. In addition, the interface typically has a logical structure underlying it. Ensuring Soldiers understand this structure, and have mastered basic skills will facilitate training and provide the essential information when training time is limited. Additional exercises can be provided to ensure Soldiers can use other aspects of the software, but without requiring formal instruction. Such a training approach was never observed, but the benefits of this approach became evident while watching how Soldiers interacted with digital systems.

When features in software interface on digital systems are similar to commercial software systems, positive transfer has also been observed to occur. Transfer has been observed with messaging procedures that are similar to commercial software e-mail displays and functions, use of icons (closing a window or file, expanding or minimizing a list of files), use of scroll bars, cutting and pasting text or figures, and so on.

However, one should not necessarily expect good performance on a particular skill to lead to comparable performance on what appears to be a related skill. Field observations showed that certain steps or procedures did not necessarily transfer because of differences in equipment or other factors. This lesson also relates back to a lesson cited earlier in the report – assess prerequisite skills and knowledge. A pretest must verify that Soldiers know how to perform a certain task and also verify the framework used to train the task. If positive transfer is not expected, the trainer must ensure that Soldiers "unlearn" previously learned steps and procedures, or learn to clearly distinguish between them if a different operation is required by the new system.

Even though the concept of boresighting an optic or device to the barrel of a weapon has general applicability, the specific steps associated with each optic or device typically differ. Directions and markers on some systems indicate "up" in order to move the strike of the bullet upwards, while on other systems an adjustment in the "up" direction will actually move the sight reticle up, which moves the round impact downward. Also, the dials and knobs are calibrated differently so each increment of adjustment is not standardized. Consequently, the trainer must be aware of the Soldiers' background when training this task. The trainer must be clear when showing and demonstrating a particular boresighting procedure that Soldiers recognize where similarities exist among weapon devices, and, more importantly, what steps, functions, or actions are different, and which apply to each device.

There can be many variables that interact in order to properly operate and employ complex systems. Given this extremely interrelated functioning, some variables might be integral to selected tasks, and not be apparent in related types of tasks. For example, a Soldier might be able to effectively engage targets using a particular weapon system and optic device combination, while not being nearly effective with the same weapon system using a different optic or device. While the performance difference could be related to the optic or device, it could well be linked to proper use and employment of the entire system. Lack of transfer was observed with Soldiers firing different night optics. Those who performed well using night vision goggles and aiming lights did not necessarily perform well using a thermal weapon sight. These differences might have occurred because of the unique ambient light conditions at night. But they also could have occurred because the critical stimuli for the integrated act of shooting varied considerably with the two devices, requiring changes in the technique of fire, such as scanning and weapon stabilization. The point is that as systems become more complex, how best to train one part of a system might not be very effective for related/similar systems or other parts of the same system. Analysis must be conducted to evaluate the specific factors that influence the final performance and then determine how best to train the different parts and processes.

Lessons about transfer were also gained from experiments with training thermal signatures of vehicles. In these experiments, transfer was higher from white-hot night imagery to black-hot night imagery, than to black-hot day imagery. The explanation for this was based on the degree of overlap in stimulus features or cues between the trained and the transfer setting. There was less overlap in cues in going from the white-hot night imagery to black-hot day imagery, than in going to black-hot night imagery. Thus trainers need to stress how the unique cues associated with day thermal imagery differ from those associated with night imagery. The trainer cannot assume proficiency in identifying vehicle signatures at night will transfer to day.

A natural corollary to this lesson is that trainers need to determine and recognize when skill transfer will or can be expected to occur. When conducting task analyses, it is important to note similar or related tasks, steps, or procedures, and distinguish the steps that facilitate transfer from those steps that will interfere with transfer. What tasks or parts of tasks can be used as building blocks for other tasks or which do not need to be repeated need to be recognized. Using the optic boresighting example, the concepts and principles of aligning an optic to the bore of a weapon and making adjustments can be presented as an introductory block of training. Then, optics that are adjusted in the same means do not require a complete new training session, but merely a reminder of the transfer from the prior training and perhaps a hands-on PE to verify that the Soldiers do know the skill.

Nonetheless, it may not be possible to determine apriori whether transfer will occur based an analysis of the task, Soldiers' knowledge, or the cues and attributes involved.. When in doubt, the trainer should work with Soldiers to try to identify when transfer occurs, and then modify the training approach as necessary.

Provide input to represent the environment when training digital systems. When conducting live training in a field environment, the sights, sounds, and actions of other Soldiers can be sensed first-hand. However, if others are not participating within your "sensing space," then you will not be aware of their presence and actions. The same situation can occur when training digital system skills. Many of the Army's digital systems allow the Soldier to observe or track other individuals via electronic locating devices and through digital information sharing and display. The sensing space is expanded. However, unless actual participants are present in this expanded sensing space in the training medium, their location information cannot be detected and provided. Therefore, to train users on digital systems, e.g., to allow them to experience observing and tracking others and to train them on tracking skills, inputs that represent the "environment" must be interjected into the training medium. This is especially critical when using the actual system or a computer-based version of the system in a virtual or simulated setting, since other participants are not typically present in the simulation of the "real world" environment.

However, only relevant cues are needed; that is, those cues or stimuli that direct significant action. Other aspects of the situation do not need to be presented (Cronbach, 1963; Gagne, 1965). Our training observations and experiences have shown that these critical cues are not necessarily easily identified, particularly when knowledge of the performance requirements of the equipment or the operational environment is limited.

The examples provided here illustrate some cues identified as important for critical tasks. When using GPS and information networks, some digital systems allow the user to view a display that shows the location of other friendly elements on the battlefield. This capability permits the user to see and know where friendly forces are located, hence to be more aware of surroundings. In order to demonstrate and to train the use of this situation awareness (SA) capability, Soldiers must be able to see the SA icons of other personnel or units. If the other participants are not physically present, such as in a classroom for ICW or in a virtual environment and even on the battlefield, icons representing these elements will not be displayed. Likewise, these icons must be able to move on the display representing that the elements are moving on the battlefield, so the Soldier can learn the proper and effective application of SA displays.

Another example is using a digital system for navigation. Generally, position location, grid coordinates, and map displays are relatively easy to train. However, to demonstrate and practice tracking movements over the map sheet within the training media, there must be some input from the environment to show that the user's icon is moving over the map and the coordinates are changing, even though the user might remain in a stationary position (such as in a virtual environment or in a classroom).

Training some digital skills may require visual input representative of combat. For example, Spot Reports are often based on what the Soldier sees, and the challenge is how to train Soldiers to send the appropriate information. ICW is often used to train Soldiers on the format of digital messages. But how to visually represent combat scenes in such ICW lessons (static vs. moving images, day and night images) so Soldiers learn when their message content is complete and appropriate is a challenge that must be addressed to provide the critical training cues.

A final example is the ability to transmit and receive both voice and digital messages. The Soldier needs some source from the operational environment to provide this interactive input and response. Without these real world interjections to represent the environment in the training medium, the Soldier will not be able to experience how the system will operate in the context of the actual environment.

Use a problem-solving, learner-centric (constructivist) approach where appropriate. As mentioned in previous sections, there are a variety of training approaches. Each has its appropriate circumstances for use. Many Army trainers tend to use a lock-step approach and have not learned another very useful approach, known as the constructivist training methodology (Childs, Schaab, & Blankenbeckler, 2002). This is basically a problem-solving, learner-centric approach. This approach was used very successfully in training new Soldiers how to operate and employ the capabilities of a digital system.

The constructivist methodology tailors training to meet individual Soldiers' needs relative to their learning levels. Constructivist training requires individuals to employ or engage technologies and capabilities of greater complexity to solve the problem or respond to unexpected circumstances. In the situation referenced above, the trainer focused on linking the digital system's operating procedures to solving a problem or accomplishing a mission, not just learning the steps or procedures. Trainers presented complex and varied problems that caused Soldiers to not only think about what they were doing, but also why. There was minimal lecture and formal presentation; trainers intervened in the learning process when Soldiers require a new level of information or assistance. The learning environment actively engaged the Soldiers so they could acquire the specified competencies. The trainer served as a mentor or coach to guide the Soldiers' practice of skills. The trainer coached by listening to Soldiers' responses and identifying weak areas in comprehension. Since Soldiers typically function as part of a team, this method included both individual and team learning as well.

With a constructivist approach, the learning occurs through scenario-driven problem solving. The scenarios should represent actual missions that the Soldier is expected to encounter on the future battlefield. These scenarios and the application of new capabilities and technologies should progress in complexity as Soldier proficiency increases. Trainers should encourage Soldiers to think about why they are responding or performing in a given way; let them try new solutions to problems, assess the success of their solutions, and then share and compare their learning experience with peers. The training should not be just a Soldier learning how to operate a piece of equipment or perform a task, but rather present an environment that enables Soldiers to learn how to employ the equipment or skills to successfully accomplish missions as a team.

Expand New Equipment Training Team (NETT) responsibilities and leave-behind materials. When the Army fields new major equipment systems, a NETT is sent to units to train leaders and Soldiers how to operate the system. This training frequently focuses on the rudiments of system controls and maintenance of the equipment. While this training is extremely valuable, it frequently does not go far enough and train-the-trainer methods may incompletely address the training requirement of enabling unit leaders to independently train new members and to sustain individual and collective skills after NET.

Leaders and units must understand how to employ the new equipment as well as how to operate and maintain it. New equipment usually provides new capabilities. These capabilities most likely allow units to accomplish missions differently. The NETT should have the responsibility to introduce new operational employment concepts and potential changes to doctrine. The training time should include more than rudimentary skills, it must require leaders and units to actually employ the new capability in operational settings. They must understand how to integrate the new capability into the organization, how to fight with the new system, and be given the opportunity to benefit from the NETT experiences. This also allows the NETT members to expand their breadth of knowledge on employment capabilities that can then be passed along to subsequent units as they are trained.

Frequently, the expertise for training new equipment is resident only with the NETT members. They become experts on equipment operation and usually do an outstanding job of transferring this knowledge. The piece that is often overlooked is what happens once the NETT departs. Leaders and Soldiers need to sustain their new skills. New members join the unit and must learn the new equipment information. Unit personnel will know how to operate the system, but will likely not be skilled to a sufficient level to train new unit members. To fill both voids, sustainment training and training for new arrivals, the NETT should be responsible for developing and leaving behind training materials that will meet these needs.

The leave-behind materials should also focus on train-the-trainer specifics, that is, how to diagnose weaknesses, to train, and to assess performance as opposed to what to train or what to learn about the system. Typically, the NETT materials have been examined during technical and operational training, and modified accordingly to enhance Soldier performance. It is important to convey these lessons learned and training tips so unit personnel benefit from them. For example, trainers should have identified the most difficult tasks by this point, and the rationale for the techniques that enhance performance on these tasks is known. Special presentation techniques, specific training sequences, and practical exercises. that trainers have learned should be shared. Such information can easily be included in the training materials themselves. Information on what did not work could be included as well. Lastly, the means for assessing performance should be shared.

Virtual and Constructive Training Lessons

The topics included in this section are listed in Table 3. Topics are not listed in any specific sequence.

Table 3
Virtual and Constructive Training Lessons

• Realize and accommodate strengths and limitations of using virtual environments to train Soldiers
• Be aware of distractions or potential sensory overload in virtual environments
• Realize strengths and limitations of using games to train Soldiers

Realize and accommodate strengths and limitations of using virtual environments to train Soldiers. One critical point is that trainers must know the strengths and weaknesses of the virtual environment, assess what can and should be trained with this medium, and then develop the training that best fits within the training environment. The virtual environment, through the use of a virtual training system, has been viewed by many as a way to train almost all individual and collective skills. However, our training research and observations have shown that virtual environments do have limitations. The benefits of virtual environments that we have observed are summarized first.

Virtual simulations have shown promise as a mission rehearsal tool, primarily at the walk level training phase. Leaders and Soldiers can practice an operation, gain a feel for the operational layout of buildings during an urban operations scenario, learn to anticipate where problems might be encountered, develop solutions to overcome them, and better prepare themselves for an actual operation. They can execute a mission against different opposing force situations and assess how best to counter the threats they might face. They can capture a fairly accurate record of what occurred during a rehearsal to facilitate a detailed AAR following mission execution. They can also practice operations in environments and under conditions that present hazards that could not be safely or economically replicated in available training areas and facilities.

Virtual training environments can be effective training tools to enhance cognitive skill development (knowledge, awareness, and judgment) at selected stages of training. For example, decision-making skills, practicing to maintain SA, and learning the impacts of system employment are just a few of the tasks where the virtual environment might provide a better training opportunity than the real world. Leaders can be subjected to fast-paced exercises that require them to track and be aware of critical events, receive and process inputs and incomplete information, assess situations, make rapid decisions, and then provide orders to subordinates. The results of the decisions can then be evaluated through the simulation being run in the virtual environment. In this manner, leaders can be placed in demanding situations, events can be replicated, and decision-making skills improved without requiring Soldiers to spend their time to assist with the leader training and without expending fuel and ammunition.

Leader training using simulations can also include operational planning, command and control, direct fire control and fire support coordination. In some cases, the virtual environment can be used to train leaders and operators on the use and employment of new equipment or operational capabilities before the actual items are available to the unit. Use of the virtual environment for collective training can enhance leader and Soldier shared understanding of mission requirements and consequences of decision and actions.

However, there are technological shortfalls with virtual environments that impact tactical missions and can limit the tasks to be trained in these environments. One problem is that interface and technology difficulties in the virtual environment for dismounted Soldiers impose limitations on tactile skills (touching or sense of touch) and precision in coordinated positions and movements by both individuals and collective groups such as a room clearing team. As a result, the virtual environment in its current state of technology does not appear to be as effective as live training for tactical training of many small-unit combat tasks or battle drills. Current technology in three-dimensional environments causes such anomalies as Soldiers' arms or extremities sticking in or protruding through walls, and flagging (silhouetting or exposing oneself or weapon barrel in doorways and windows). The loss of tactile sensing also makes it difficult for squad members to maintain physical contact with each other during stacking outside a building/room, precision clearing operations, and close maneuver in confined locations.

Visual shortfalls also impact the types and results of training that are effective in the virtual environment. The use of hand/arm signals and eye contact frequently used by small teams as communications techniques are currently absent in virtual environments, although work is being done to fill this void. There is typically a limited field of view that eliminates or greatly reduces peripheral vision. Simulating night conditions is possible to some degree in most virtual environments, but technical solutions to replicating or providing the various night vision situations encountered by Soldiers are still being developed. The background environment can be turned dark or obscured by smoke. However, dynamic night imagery that corresponds to the changing ambient light conditions at night, to the thermal signatures produced by night sights, and/or to the near infrared images associated with night vision goggles are missing from the virtual environment.

The method applied represent to weapon systems in a virtual environment can be devoid of realism. In some experiments we observed a high rate of fratricide because weapons, specifically grenades, were operated very differently in the virtual environment from the real world. In the virtual setting, the Soldier could not exhibit any throwing motion for grenades. The technical solution was to have the Soldier gauge the arc and distance from a visible moving scale. If incorrect steps were followed, the grenade fell nearby, causing friendly casualties. The grenade often became the principle cause of fratricide due to the physical manipulations of the virtual environment interface required to throw it. Incidents such as this are extremely rare in the real world. Also, in some instances, the Soldier had to use a menu to choose whether he wanted to shoot the rifle or throw a grenade. This was time-consuming and sometimes resulted in the wrong selection. This would not be an issue in the real-world environment.

A thumb switch on the weapon is usually the means for a Soldier to move through the virtual environment. Maneuverability on the part of the Soldiers is thereby limited. Further, Soldiers do not have the sense of actually moving and do not experience some of the difficulty of performing other tasks while moving.

In summary, continued work on making dismounted infantry Soldier virtual training environments more realistic should overcome some of these problematic areas in the future. The areas requiring the most work are in the area of communications other than voice, such as hand/arm signals and "follow-me" leadership as practiced by team leaders. Dismounted infantry Soldiers must be able to see each other in a dismounted virtual world, as well as be able to see and interact with their future combat systems and other combat and combat support systems. Not only would this type of environment be useful for training, but would also prove invaluable in creating and testing TTP. Until the virtual environment acquires such needed capabilities, trainers should use the advantages offered by the virtual environment to train only the appropriate tasks and be aware of the training shortfalls.

Be aware of distractions or potential sensory overload in virtual environments. Our observations indicated that Soldiers tended to get caught-up in or overwhelmed by aspects of the virtual environment. The result was that Soldiers missed auditory or visual cues and signals that should have indicated immediate danger. While this same occurrence could transpire in the real world, indications were that certain factors in the virtual environment contributed to this problem.

The Soldiers typically wear headphones and the volumes are not always properly adjusted. They might have the volume too high which could overpower environmental signals. Or the volume might be too low to hear intended signals. This issue can be addressed by ensuring that Soldiers are informed about this problem and take the time to properly adjust audio volumes for the environment and conditions.

In other cases, Soldiers became so preoccupied with manipulating controls on their virtual systems that they were distracted from their actual mission. This may have been due to their level of training, lack of familiarity with the controls, or limited proficiency with the virtual system. The controls are frequently somewhat different from actual equipment controls. This problem can be partially overcome by providing adequate training on the use of the controls and allowing Soldiers ample time to practice with them. Just as Soldiers learn to become proficient in operating equipment in the real world, they must be allowed time to learn to operate the virtual environment controls.

Another potential cause of the missed cues could be sensory overload. Typically, Soldiers in a virtual environment will have access to and be provided more information than is routinely available in the real world. Until they adjust to handling and processing this increased information flow, trainers should use caution. The information flow should be realistic and representative of the anticipated real environment. Just because more information is available does not mean that it should be provided to the Soldier.

Realize strengths and limitations of using games to train Soldiers. Time and money have always been two main resources that impact Army training. Therefore, the Army has sought the most efficient means possible to train Soldiers. One of the means being explored is the use of games and gaming technologies. In some instances the Army has worked closely with the companies that produce commercial games in an effort to modify these games to train specific tasks. To ensure games properly address Army doctrine and tactics, the Army must provide a designated SME to devote time and assistance to game developers. This detailed input is essential to ensure that games reflect current doctrine and the training objectives of the games are clearly addressed.

Even with extensive SME involvement, the use of games for military training still has drawbacks. It is like trying to take a war movie and make it into a training film. The commercial producers and director want to make the games dramatic, suspenseful, and fun. The Army wants games to accurately reflect the training material and events, and to focus on specific training objectives. The two viewpoints must be brought to a common ground for games can be useful training tools.

Another drawback is the tendency for Soldiers to use "gaming" techniques to win the game. In other words, users will find ways to "beat the game," and will not necessarily learn the correct skill for accomplishing the operational tasks of interest. These winning ways may negate the positive training value a game might have by circumventing proper techniques and procedures that Soldiers should use in live training and combat operations. This can result in negative training and negate potential savings in time and dollars that might have been realized from using the game.

Finally, another concern to keep in mind is that games do not automatically provide training nor the needed training. Games intended for a squad leader should be designed differently than games designed for a company commander. Modifying or building upon the format of a commercially available game may be appropriate for one Soldier audience but not for another. In addition, although games can provide an environment in which Soldiers can practice skills and experience different conditions, unless specific provisions are made for trainer feedback, the game does not provide training. For the Soldier to gain the benefit from using a game, a trainer (e.g., supervisor or leader) is usually required to observe the Soldier's performance during the game execution. The trainer uses available information and his own expertise to assess Soldier actions and provide feedback, either during execution or as an AAR. It is through this trainer-Soldier interaction that training occurs, not necessarily from playing the game.

Just as with the virtual environment, games can offer an advantageous training opportunity for selected tasks. Soldiers and leaders can try different operations and capabilities to assess what actions might provide a better battle outcome. Leaders can refresh planning skills and practice employment of appropriate assets (e.g., timing for the use of indirect firing) without expending more costly resources and requiring other units or Soldiers to participate. Games can be an effective complement to a training program, provided the trainer recognizes limitations of games by incorporating them appropriately in the program, observes Soldier performance during the game, and provides feedback.

Other Training Lessons

There are two main topics addressed in this section, ICW and AARs, plus one other significant lesson learned. Both the ICW and AAR topics have multiple key lessons and each topic relates to training lessons presented in the other sections of this report. The topics included in this section are listed in Table 4.

Trainers need to be trained to identify and use the appropriate training approach. As the Army transforms and digital capabilities within systems become more prevalent, smaller more agile fighting elements will likely be deployed on the battlefield. These fighting elements will be dispersed and will need to be aware of other actions around them. Evolving doctrine already emphasizes information dominance and superiority over the enemy. As organizations become more dispersed, the importance of connectivity between commanders and small units will increase. This means that leaders at lower levels will assume greater operational responsibility for executing missions. These small unit leaders must be trained for this increased responsibility, to process information quickly, and to solve challenges on the battlefield. The Army, its leaders and trainers, must implement the appropriate training techniques using the appropriate training materials to prepare these leaders to the required competency levels.

Table 4
Other Training Lessons

• Trainers need to be trained to identify and use the appropriate training approach
Interactive Courseware (ICW)
• Employ strict configuration management and implement accepted procedures for development of ICW
• Implement quality control measures throughout ICW development
• Adhere to the same file naming conventions throughout ICW development
• Understand and conform to the Shareable Content Object Reference Model (SCORM)
• Test ICW install sets under conditions similar to those used by the intended target audience
• Determine server capabilities that will host the ICW
• Develop and use templates to expedite ICW development and updates
• Determine the details needed for user performance records
After Action Reviews (AARs)
• Allow sufficient time for AARs and conduct AARs at all levels
• Have a means to easily identify small units and Soldiers in exercises for AAR identification
• Use a building floor plan or pre-established grid and quick-reference codes to track exercise data in urban operations
• Have user friendly systems to support AARs in virtual and constructive environments

To properly train these small-unit leaders as well as Soldiers, trainers in TRADOC classrooms and in the field must understand and implement training methods and approaches that produce success. Trainers themselves must be trained. The lessons discussed in the previous sections are certainly applicable to this training requirement. In addition, trainers must learn how to execute or facilitate different training approaches, understand the circumstances where each approach is best used, and how to determine the circumstances that should influence the training approach. For example, the "explain – show – guided demonstration – practice – practical exercise" approach might be appropriate for complex tasks with less experienced Soldiers when a thorough understanding of task accomplishment is required. This approach might be the situation for the initial stage of training on a new system. However, as Soldiers start to grasp the material or the target audience has prior background in the tasks, the trainer might then switch the mode of training to a problem-solving approach or presentation of more complex problems.

In the 1990s, the Air Force recognized a need to provide guidelines to instructional designers who were developing interactive courseware (Spector, 2000). The guidelines, called the guided approach to instructional design advising (GAIDA) were based heavily on Gagné's writings (Gagné, 1985; Gagné & Briggs, 1979). This fairly recent effort by the Air Force confirms the importance of adequately preparing trainers and training developers to be knowledgeable regarding effective training approaches.

ICW: Employ strict configuration management and implement accepted procedures for development of ICW. Configuration management is vital to a successful ICW project. There are two separate issues: verifying the anticipated user system configuration and capabilities, and management of the files or naming conventions (file management is discussed in a subsequent lesson).

There are countless possible configurations for a user's computer. For example, the user may not have sufficient amount of space on a "C" drive, or the user may not have a "D" drive. Therefore, software engineers must design a flexible install program that allows the user to select the drive to be used. Operating systems will vary, including all variants of Microsoft® Windows (e.g., 2000, XP, NT). Users will undoubtedly have different browsers, such as Internet Explorer, Netscape, Mozilla, and a few others that are less well known. To help avoid potential problems in this area, the ICW instructions should indicate the oldest possible version of Windows that will work and specify the best browser to use.

Software engineers should keep operating procedures and instructions as simple as possible. Plug-ins and browser settings represent two additional potential problems. There are a few rules that could assist with avoiding these problems. First, avoid a plug-in that requires the user to pay for it. Plug-ins should be offered free from the developer, or on the site that delivers the training, without violating licensing agreements. Second, anticipate problems and develop troubleshooting solutions for those problems. A program designed specifically for "Help", such as Robohelp, can be used or "Help" can be authored in hypertext markup language (HTML). Finally, test the software. Be sure to test downloading, installing, and using the ICW on different computers through different browsers and with varied browser settings. Testers can provide information on ease of use, operating success, and areas where they had problems. They can also identify any difficulty in understanding the instructions for installing and using the ICW. Refine the software program, and test it again to ensure problems have been eliminated.

Another issue for web-based training is available bandwidth. All too often either specifications or customer expectations are not realistic in terms of what they want versus what will work. Most users who access ICW from a military installation will have access via a T1 line. However, if the intent is to allow Soldiers to access ICW from off-post locations, such as from their home, most will have dial-up connections, but certainly something with less bandwidth than the T1 access. While newer computers with a dial-up modem boast a 56 kilobytes per second (kbps) transfer rate, current telephone lines can limit dial-up connection speeds to 24 kbps or slower. This can be very frustrating for a user. Excessive waiting time to access ICW can result in the lack of use of an otherwise outstanding ICW program. Therefore, particular attention needs to be paid to how the ICW is designed and developed. The developer should attempt to reduce file sizes where feasible. This includes using graphics only when they contribute to the training and then ensuring graphics are constructed with a minimal acceptable file size.

Streaming video and streaming audio can contribute to training. Developers should use them when they contribute to the training, but optimize them for quick download and playing. Video should be replaced with animated "gif" files where possible. For web-delivered ICW, audio should not automatically start, since this will slow the rate that a web page loads. The use of automatic audio on page opening should be restricted to CD-delivered ICW. Software should allow the user the opportunity to either listen to the audio or read a text pop-up that delivers the exact same information. These configuration tips will make web-delivered ICW less frustrating for the user and result in a more pleasant learning experience.

Not only must the developer be concerned with configuration issues for the user, but must also address configuration management for the ICW development effort. All ICW must operate efficiently and effectively on a computer that meets the Army Training Information Architecture (ATIA) requirements. These ATIA requirements include specifications for the computers and networks that will be used to present ICW in TRADOC schools. The ICW must run and function properly within the requirements set by TRADOC and the Army Training Support Center (ATSC) (ATSC, 2003).

ICW: Implement quality control measures throughout ICW development. Quality control is essential and consists of checks throughout the ICW development process. Quality control begins with the training content developer or SME who must ensure that the information within the lesson is accurate. The SME must also ensure instruction follows an appropriate approach for the target audience, such as sequence, checks on learning, evaluations, and performance feedback to the user. When developing ICW, the storyboards must represent the training content as well as the vision that the SME had for the presentation of the material. That is, they must indicate to the graphic artist and programmer how the program is to flow and how it should react to user input. Once the graphic artist has completed all the graphics for the ICW lesson, the SME must ensure the graphics represent the vision for the instruction and that they contribute in a positive manner to the lesson objectives. The SME must also check any and all audio that is created for the lesson for proper pronunciation, especially military terms and acronyms. The programmer then assembles the lesson using the storyboards as a guide, to ensure that the ICW works in the manner prescribed by the SME. All developers must self-check their work. Once the ICW is ready for review the SME will perform a quality check for spelling, accuracy, flow, navigation, and presentation. Only after these complete internal reviews and corrections are accomplished should the material be provided to the customer or users for review. Configuration management assists with tracking the development and quality control status. Different configuration versions can be used when the material has been reviewed by the appropriate persons to ensure reviews occur at the right times, and that appropriate corrections have been made following reviews. A central individual responsible for this can perform tracking, or it can be done by software that requires ICW lessons to be checked-out and checked back in. This precludes losing fixed lessons or any confusion concerning which ICW lessons are ready for the user.

Quality control also includes the SME's review of the initial ICW product and later revisions. These reviews are essential to having a product that is reliable, error free, user-friendly, and accomplishes its purpose. When the storyboard is finally presented on the computer or over the web in an interactive program, it may not function as the SME had envisioned. The time required for SME reviews must be considered in the development process. The SME review can be a painstaking process. The SME must progress through the program multiple times, using all the available paths and exploring all options provided. The SME should think like Soldiers who will use the program, and try to replicate the mistakes Soldiers are likely to make and the short cuts they might attempt.

Documenting and explaining problems to the software engineer are also critical to ensure the SME's intent is understood. There are several ways this can be accomplished. An SME can save screen prints of displays in a document and insert comments on the copied visual display to describe the problem. Another approach is to have the SME and software engineer discuss the changes while electronically sharing the same screen views. The programmer can see the location of the SME's cursor, and the SME can see the changes as the software engineer implements them. If the change is minor, such as a change in the screen text, this latter option may be sufficient for quality control. But for more substantive changes that involve a modification to the branching features of the courseware or inclusion of new screens that take time to develop, additional quality control steps.are needed. Our experience shows that once the programmer makes such changes, the SME must then recheck the entire program again, to ensure it functions as desired. It is often advisable to have an additional person not familiar with development of the ICW to function as an SME during this process in order to obtain multiple perspectives on how the program can be improved.

ICW: Adhere to the same file naming conventions throughout ICW development. Having a file naming convention seems like an innocuous and somewhat trivial thing, but it is not. File naming conventions must be planned during the initial design phase and adhered to throughout the entire development of an ICW project. Files and objects that are named without a recognized convention are hard to find when trying to make fixes or update ICW. It might be difficult to determine which files relate to which ICW topic, lesson, or course. Using a systematic means of naming files can make locating or identifying specific pages or lesson material easy to find, fix, and reinsert without having to modify links or other file names.

ICW: Understand and conform to the Shareable Content Object Reference Model (SCORM). SCORM is a collection of standards and specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility, and reusability of web-based training. Conformance to SCORM ensures that an ICW course delivered via the Web is reusable, sharable, and can be located for future reference. The sharable content object (SCO) or training topic must be small enough to allow chunking of material, yet large enough that it covers a specific performance task that can be measured. The SCO must be free of external navigation so it may be reused in other ICW without breaking links. It must contain a variety of important commands and files that make it work within the conformance of the SCORM and with a variety of learning management systems (LMSs), which are also SCORM conformant. These requirements are important, especially to ICW that could also serve as Help files for software-based command and control systems, or as embedded guides for operators (how-to-operate) and supervisors (how-to-employ). SCORM 1.3 conformance will help to attain these goals for newly fielded software and hardware systems (Advanced Distributed Learning, 2004).

ICW: Test ICW install sets under conditions similar to those used by the intended target audience. Install sets for training software are difficult to develop depending on the actual method of delivery and the anticipated computer literacy level of the person who will use the install set. Ease of use by the Soldier is critical. Whether the ICW will be web-based or CD-delivered is also an important factor. Once the install set is developed, it must be tested by a variety of people. Using different personnel installing the courseware both from different computers and different locations (e.g., at work and at home) is essential to the development of successful, easy to use, and intuitive installation sets. This process usually requires some troubleshooting to determine why certain features might not function as they should. Because each ICW is somewhat different, progressive technology allows the creation of install sets more and more tailored to the needs of a variety of users. For example, during the development of one ICW course, where the user was required to use a particular authoring system, it was quickly learned that the software did not stream as the vendor stated. As a result, it was much easier for the user to download lessons and complete them off-line. This ICW course was developed with an interface that allowed users to access one of two forms of lessons – one set with audio for those users with broader bandwidth, and one set without audio for those with lower bandwidth. Once the course was migrated to the Army's Reimer Digital Library, the lessons and tests were streamed, but the installable lessons also remained on the web. Most students used the downloadable lessons to study, and went on-line for the examinations resident on the Reimer Digital Library.

Other ICW projects required different approaches. It is important to understand when and how the user will want to access the ICW so the install set provides useful options. For a different project that was developed with HTML and Flash, install sets were created that allowed users to download specific lessons or even make their own CD for local distribution if Internet access was slow or unavailable. This feature became popular during extended deployments to Iraq and Afghanistan.

ICW: Determine server capabilities that will host the ICW. Server issues must be dealt with during the design phase of a project. Who will provide the server? Will the design and development team have access to the server to transfer files? Is the server capable of handling the expected student load? Will the server contain a learning management system (LMS)? Who will have access to the LMS during the development and delivery of the product? Can the LMS handle sequencing of instruction and the role of providing users a menu, rather than building a menu into the ICW? Who will maintain the server? Are there firewall and security issues that could preclude user access? Will there be mirror sites in the event the server goes down? Are there issues with plug-ins and end-user downloadable files that enable the users to access the ICW? Are there license issues that must be resolved prior to final delivery? All these questions and others must be answered. There is no single correct answer, since each case has its own problems, challenges, and solutions.

ICW: Develop and use templates to expedite ICW development and updates. One other key issue to developing ICW concerns the use of templates for web-delivered material. Templates are critical to the effective and efficient use of the Internet as a delivery tool for ICW. When universal changes need to be made to the ICW, templates allow changes to be made very quickly. Without proper templates, any universal changes can become nearly impossible to accomplish and are cost prohibitive. For example, if the developer wants to add a glossary to the ICW and there is no means to navigate to the glossary in the original courseware, a navigation button would need to be added. Templates allow the development team to add that button very quickly. A lack of templates requires that each and every page within a course be modified to add that button.

ICW: Determine the details needed for user performance records. The level of detail saved with regard to Soldier performance records can also be an issue. During development of the ICW or for the purposes of training research, more Soldier performance data may be required than when the product is integrated into a military course. The type of feedback needed must be thoroughly discussed early-on with the SMEs so the appropriate databases are created and maintained. In addition, how the data can be summarized in a user-friendly manner for training analysis purposes, both diagnosis and assessment, must be discussed and all issues resolved.

AAR: Allow sufficient time for AARs and conduct AARs at all levels. During training exercises and experiments, evaluators or observers/controllers (O/Cs) are usually allocated time to prepare material to conduct an AAR. Depending on the event, the amount and type of data that is captured and the organization's size, varying amounts of time are allocated for preparing and conducting an AAR. These AARs can be extremely beneficial learning opportunities and they should reinforce the training value of the event.

The shortcoming at times, however, is that the lower echelon leaders rarely have the opportunity for this extensive AAR process when participating in larger scale events. Unit leaders, down to and including the fire team, should be allocated time and have access to the available resources to prepare and conduct their own AAR. While not always readily accessible, support such as video playback, exploded building floor plans in training simulations, or data from live and simulation instrumentation systems should be provided to the leaders. Evaluators and O/Cs could provide assistance to these leaders and facilitate this learning experience. As junior leaders become more proficient in conducting AARs and an array of off-the-shelf templates are developed for input to AARs, evaluator or O/C participation can decline. If AARs are as useful as trainers espouse, then they should be implemented at all levels for all events. As the adage goes, "the chain is only as strong as its weakest link." The Army's small-units should be made stronger through the AAR process.

AAR: Have a means to easily identify small units and Soldiers in exercises for AAR identification. The AAR is an important learning opportunity in training, be it live, virtual, or constructive. When reviewing observer notes or any post-exercise video recordings for AAR purposes, Soldier identification is particularly valuable in order to assess what happened, who did what, and where improvements might be needed in Soldier or unit performance. During live exercises, O/Cs should be instructed to capture information concerning individual Soldiers or small units who were involved in a critical event or activity. This allows the AAR facilitator to draw first-hand feedback from the individuals who participated in the key event. This aids in providing better insight into why certain actions were taken, and what was known and being considered by the individuals. These insights can contribute to identifying why something worked well or might need to be modified. The level of detail tracked (individual Soldier or small unit) will vary with the echelon of the unit being observed.

Live urban operations exercises are frequently conducted at instrumented military operations in urban terrain (MOUT) training sites. These sites may have a system that can provide data on individual Soldier performance (e.g., location, each firing engagement, and firing results). In some cases, such data may not be available due to lack of complete instrumentation in the MOUT site or instrumentation malfunctions. In these cases, O/C observations and the post-exercise video recordings can be used to obtain and review individual performance. At a MOUT training site, it is frequently difficult for an O/C to clearly distinguish individual Soldiers in a fast-paced exercise where visibility is usually obscured (e.g., smoke, poor lighting conditions, night time). Another complicating factor is that all participants might wear protective gear to prevent injuries from paint ball projectiles. Under these circumstances it can be difficult and time-consuming to track individual actions and specific participants when reviewing video of the exercises. If detailed data concerning individual performance are desired, it is recommended that participants use some form of identification system. This could be a vest with an alphanumeric combination or different symbols, or identifying headbands on helmets with markings front and back. The key is to establish some unique marking that each Soldier will wear, so each individual can be easily identified in the video recordings following the exercise. These same techniques could be used in other terrain settings, but individual identification in more open or wooded environments does not pose the same problem as in the confines and fast-paced activities of clearing rooms and buildings in urban operations.

AAR: Use a building floor plan or pre-established grid and quick-reference codes to track exercise data in urban operations. Frequently, written notes will suffice to capture data needed to conduct an AAR following an exercise. Unfortunately, accurate written notes are difficult to maintain during a series of fast-paced events. We found that one change to the normal notes proved highly successful in live MOUT training exercises. In addition to a performance evaluation checklist prepared for the exercise and short observation notes, a floor plan of each floor of the buildings was prepared and placed on a clipboard. On the floor plan, each room, hallway, stairwell, etc. was numbered for quick-reference. Incidents and their sequence were then marked on the floor plan via pencil during the course of the actual mission. Arrows drawn on the floor plan were used to track critical movements or the flow of events. The exact location and number of incidents at any point was then transposed to the evaluation checklist. This tracking made it easy to follow the flow of the events and know where specific incidents occurred. For fast-paced movements in mounted organizations or for maneuvering in a congested area (e.g., urban terrain) a detailed map, sketch, or pre-established grid system with checkpoints can facilitate more rapid note taking by an O/C and provide more in-depth information for an AAR.

Likewise, data collectors can establish quick-reference codes for exercise participants and anticipated actions. Individuals can be assigned codes for quick-reference and for easier identification. Using quick-reference codes allows an O/C to rapidly record results that should provide a more accurate capturing of the events. This technique allows O/Cs and trainers to establish a clear distinction between forces on the battlefield, friendly and enemy, as well as the non-combatants.

AAR: Have user-friendly systems to support AARs in virtual and constructive environments. Future enhancements to AAR tools for virtual and constructive simulation training environments should focus on a user-friendly interface that allows Soldiers or leaders themselves to operate the system with minimal train-up and practice. Typically, a dedicated, trained operator is required to generate the AAR output for a leader's use from events that occurred during the exercise or operation. User-friendly AAR systems should provide such options as setting and changing preprogrammed views, stealth views or free-flying through the environment to permit different views of the exercise, and rapid access of flagged events at optimized views. When conducting urban operations, the AAR system should also have the ability to show Soldiers by floor in multistory buildings to permit portrayal of movements on each floor level. Each of the AAR functions needs to be refined and simplified so extensive skill and practice by the trainer are not necessary.

An AAR system with a built-in graphics generation package would be helpful. This package, with Microsoft® PowerPoint or similar capabilities, could be used to generate training support materials for the AAR. Word charts or graphic illustrations could be used to support training objectives in whatever format unit leaders and trainers would choose to use for the AAR and training process. While some sophisticated systems might have these capabilities, efforts should be made to include these features in smaller scale systems.

Conclusions

The lessons presented in this paper are a result of first-hand observations of Soldier and leader training as well as training research. They represent the analysis and assessment derived from hundreds of hours of training and training research over nearly an eight-year period. In some instances the lessons are relatively new, having emerged as a result of changes in technology in Army systems and in training support. While offering an increase in combat capability, the advent of more technologies also provides challenges for trainers and the training community. Other lessons are based on fundamental learning principles that have existed for years, but are being applied in new contexts. An important point confirmed by these efforts is that the training design and development process outlined in the ISD process provides a sound approach for training developers.

Assessing and reviewing training analysis, design, development, and delivery yield lessons that can be valuable for future efforts. Training organizations should have a plan for assessing the variety of training courses and programs, including institutional training in TRADOC schools from initial entry training for both officers and enlisted Soldiers through mid-grade career courses, and special skills schooling. With the advent of new equipment and the accompanying new doctrine, the Army would be remiss if it did not assess new equipment training and sustainment training during the system design and development processes. As the Army designs new equipment, measures must be taken to determine how the design of a system can make training easier and more intuitive (DA, 2001). This training must also incorporate principles of learning. Despite new operational systems and new training technologies, well-established principles of learning and training still apply to the creation of effective training, and must be known by training developers and trainers. If Soldiers cannot be properly trained to operate and employ the systems efficiently and effectively, the systems will not be as beneficial on the battlefield as anticipated.

Institutional, new equipment, and sustainment training are not the only areas that require attention and the constant application of lessons learned. TRADOC systems managers must also plan for including training and doctrine in unit level training through publication of the appropriate field and training manuals, and training support packages that support mission training plans. Exporting training support packages to units who will own the new equipment, undergo reorganization, and/or accept entirely new doctrine must help the unit train to integrate previously existing systems, especially in this digital age. Training materials must help unit leaders and staffs train and prepare for war on a multi-dimensional battlefield in the most effective way possible. Linking training between the institution and unit must guide leaders in methods where they can incorporate the live, virtual, and constructive training worlds together.

The lessons presented here should serve as helpful concepts in designing and developing the optimum training for differing circumstances. A primary lesson is that trainers and training developers should be trained to identify and use appropriate training approaches. Many of the other lessons learned presented here stressed the importance of adapting or tailoring the training approach to the target audience and to the training objective. Trainers and training developers need to be aware of what works effectively for different groups of Soldiers, what training will transfer, what type of training improves retention of skills, when a training medium is appropriate and when it is not, when the training approach should be changed to adapt to the prior experience of the Soldier, when the training should change emphasis from a step-by-step mode to a problem-solving mode, and so on. It is incumbent on trainers to be continually aware of the results of training research, and to monitor the development and execution of training efforts with current and new military systems. This will allow them to identify lessons that will be beneficial in future training efforts. Many of the lessons presented here reflect timeless principles of learning and training that have been confirmed again with new Army systems. The lessons should be made available to other training developers, trainers, and equipment designers.

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Appendix A

Acronyms

AAR	After action review
ASAS	All Source Analysis System
ATCCS	Army Tactical Command and Control System
ATIA	Army Training Information Architecture
ATSC	Army Training Support Center
CD	Compact disc
CSSCS	Combat Service Support Computer System
DA	Department of the Army
FBCB2	Force XXI Battle Command for Brigade and Below
GPS	Global positioning system
GUI	Graphic User Interface
HTML	Hypertext markup language
ICW	Interactive courseware
ISD	Instructional System Design
Kbps	kilobytes per second
LMS	Learning management system
LOMAH	Location of Miss and Hit
MANPRINT	Manpower and personnel integration
MCS	Maneuver Control System
MOUT	Military operations in urban terrain
NETT	New equipment training team
O/C	Observer/controller
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
PE	Practical exercise
SA	Situation awareness
SASO	Stability and Support Operations
SAT	Systems Approach to Training
SCO	Sharable content object
SCORM	Sharable Content Object Reference Model
SME	Subject matter expert
TADSS	Training aids, devices, simulators, and simulations
TES	Tactical Engagement Simulation
TRADOC	Training and Doctrine Command
TTP	Tactics, techniques, and procedures

Appendix B

Research Reports Used in Compiling Lessons

Centric, J. H., Beal, S. A, & Christ, R. E. (2005). *Train-the-trainer package for the Full Spectrum Warrior game* (ARI Research Product 2005-02). Arlington, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

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Dyer, J. L., Singh, H., & Clark, T. L. (2005). *Computer-based approaches for training interactive digital map displays.* (ARI Research Report). Arlington, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A440 171)

Dyer, J. L., Vaughn, A. W., & Blankenbeckler, P.N. (2004). *Training on common military messages.* (ARI Research Report 1717). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A419 918)

Dyer, J. L., & Wampler, R. L. (2002). *Observations of the Land Warrior Tester Training Course #3 conducted prior to reliability growth phase I* (Unpublished special report to Project Manager Land Warrior). Ft Benning, GA: Infantry Forces Research Unit, U.S. Army Research Institute for the Behavioral and Social Sciences.

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Fober, G. W., Bredthauer, J. L., & Dyer, J. (2001). *Computer backgrounds of Soldiers in Army units: FY00* (Research Report #1778). Alexandria, VA: U.S. Army Research Institute for the Behavioral Sciences. (DTIC No. AD A399 393)

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Knerr, B. W., Lampton, D. R., Thomas, M. A., Comer, B. D., Grosse, J. R., Centric, J. H., Blankenbeckler, P., Dlubac, M., Wampler, R. L., Siddon, D., Garfield, K. A., Martin, G. A., & Washburn, D. A. (2003). *Virtual environments for dismounted Soldier simulation, training, and mission rehearsal: Results of the FY 2002 Culminating Event* (ARI Technical Report 1138). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD A417 360)

Pleban, R. J., Eakin, D. E., Salter, M. S., & Mathews M. D. (2001). *Training and assessment of decision-making skills in virtual environments* (Research Report #1767). Alexandria, VA: U.S. Army Research Institute for the Behavioral Sciences. (DTIC No. AD A389 677)

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